

**Exploring Organisational Learning in Water Resource Protection:
Activity System Analysis of Social Learning among Resource
Directed Measures Role-Players in South Africa**

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by

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March 2025

DECLARATION

I declare that this thesis is my own work, and that all other sources used or quoted have been fully acknowledged and referenced. It is being submitted for the degree of Doctor of Philosophy (PhD) at Rhodes University and has not been submitted for a degree or examination at any other university.

Mmaphefo Doreen Thwala

A handwritten signature in black ink, appearing to read 'Mmaphefo Thwala', with a stylized, cursive script.

Signature

05 March 2025

ABSTRACT

The South African government introduced Resource Directed Measures (RDM) for water resource protection towards sustainable water ecosystem management. RDM comprise of Water Resource Classification, Reserve Determination and setting Resource Quality Objectives. Since guiding procedures were published in 2010, RDM have been determined in various catchments, but a variety of challenges have hindered impact and hence the need for a study exploring organisational learning.

In a context where most South Africans lack access to a reliable water supply, and freshwater ecosystems are rapidly deteriorating, the study used an activity systems lens to explore existing organisational learnings as reflected in the insights of water sector role-players involved in over ten years of RDM in three case study contexts: RDM determination in the National Office of the Department of Water and Sanitation (DWS), and RDM implementation in KwaZulu-Natal and Mpumalanga Provinces. Underlaboured by a critical realist philosophy, using Cultural Historical Activity Theory (CHAT) analytical tools, this study surfaced contradictions as potential sources for further organisational learning towards improved water security.

Phase 1 consisted of document analysis to identify enablers and challenges in the RDM process. Phase 1 informed semi-structured interviews conducted with role-players in Phase 2, focusing on their experiences in past RDM projects and exploring whether and how learnings are evident in current interventions. Twenty role-players in the DWS were interviewed based on their knowledge of RDM determination and implementation. Three sector events were also utilised for engagements with role-players in the wider water sector. Data was analysed using CHAT framing and contradiction analysis, surfacing historically accumulating structural contradictions within these systems, including *conflicts*, *critical conflicts*, *dilemmas*, *double binds*, *tensions*, *conflicts of motive*, *disturbances* and *inconsistencies*. In Phase 3, retroductive analysis was conducted to identify possible causal mechanisms behind these manifestations of contradictions.

The study confirmed that while water resource protection has been prioritised in legislative tools, the slow establishment of functional institutions remains a challenge. Key conclusions are that, while the post-apartheid National Water Act 36 of 1998 introduced a radical object shift in water resource management, from *most for a privileged few* to *some, for all, forever*, conceptualisations of resource needs, including human resources, where they should be based, and how they can be developed and deployed, do not match the complex transformational object; and neither do platforms for organisational learning.

The findings suggest that to achieve the challenging dual RDM mandate of balancing protection and use of water resources, a range of social and technical skills are needed. In a complex activity such as RDM, capacity is distributed across networks and needs to be negotiated with others, and well convened, as and when needed, for joint action. Learning from and with each other for collective meaning-making and sense-making is therefore critical. A fundamental underlying contradiction found in this study is the overall approach to learning in the system; which should include built-in joint learning processes so that co-learning can guide decision-making.

A system for the ongoing co-development of RDM would include: (a) well-designed water resource management systems; with (b) clear definitions of roles and responsibilities for catchment and provincial office water resource practitioners, and/or mechanisms for role-players to refine their roles in practice; (c) consultative processes that are differentiated and tailored for each stakeholder group, for meaningful and active engagement; and (d) platforms and processes for learning that are well supported by responsible authorities (DWS in this instance), as implementers work out the best ways in which to achieve *some, for all, forever*. Moreover, implementers must recognise that some tasks are unpredictable and may involve flexible responses that could not have been anticipated. To do this, the study suggests that the organisation needs to convene integrated teams for RDM projects; composed of the diversity of competencies and specialisations needed, and put in place the same level of sophisticated systems for supporting RDM implementation, as for RDM determination.

To explicitly function as a learning organisation, given evident changes in the system over time, DWS needs to continuously invest in resources, including tools, budgets and staff. Together with partner institutions, it will need to convene, support and facilitate more multi-actor platforms.

This study demonstrates the value of a social learning theory for surfacing consequential phenomena and learning among role-players in organisational contexts. Given the systemic nature of organisational challenges such as capacity, participation and implementation, exploring learning and its layers of historicity was important for unearthing contradictions and their causal mechanisms for further organisational learning to strengthen water resource protection through RDM.

Keywords

Social learning; organisational learning; activity systems; Resource Directed Measures; water resource protection; integration.

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Last but not least, I thank God for giving me the strength and wisdom to overcome obstacles I came across on my journey to completing this study.

DEDICATION

I dedicate this thesis to my sons (Siyabonga and Zibusiso Thwala) and husband (Melusi Thwala). This work would not have been possible without your understanding and support throughout my long hours of research and many days spent writing. Your love, patience and encouragement has made it achievable.

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TABLE OF CONTENTS

DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGEMENT	vi
DEDICATION	viii
TABLE OF CONTENTS	ix
LIST OF FIGURES	xii
LIST OF TABLES	xiii
ACRONYMS AND ABBREVIATIONS	xiv
THESIS CHAPTERS	1
1. CHAPTER ONE: STUDY INTRODUCTION AND SETTING.....	1
1.1 INTRODUCTION	1
1.2 RESEARCH CONTEXT AND HISTORICITY	1
1.2.1 The water security threat	1
1.2.2 Importance of water for all.....	4
1.2.3 Skills and capacity constraints in water resource management.....	5
1.2.4 The need for a new lens.....	7
1.3 RESEARCH FOCUS.....	9
1.4 RESEARCH AIM, OBJECTIVES AND QUESTIONS	15
1.5 STUDY AREAS	16
1.6 STUDY MOTIVATION	18
1.7 RESEARCHER POSITIONALITY IN THE SELECTED CASE STUDIES	23
1.7.1 Importance of positionality in qualitative research	23
1.7.2 Researcher's positionality in the selected case studies.....	25
1.8 STUDY PHASES AND THESIS STRUCTURE	26
2. CHAPTER TWO: LITERATURE REVIEW – STUDY CONCEPTUAL, LEGISLATIVE, INSTITUTIONAL, AND THEORETICAL FRAMEWORKS.....	30
2.1 INTRODUCTION	30
2.2 GLOBAL CONCEPTUAL FRAMEWORKS IN WATER RESOURCE PROTECTION	30
2.2.1 Integrated Water Resources Management (IWRM)	31
2.2.2 Sustainability	34
2.2.3 Complex Social-Ecological System (CSES)	37
2.2.4 Participation	38
2.2.5 Capacity.....	42
2.3 SOUTH AFRICAN WATER LEGISLATIVE AND INSTITUTIONAL FRAMEWORKS	46
2.3.1 Legislative framework	46
2.3.2 Institutional framework.....	57
2.4 LEARNING THEORETICAL FRAMEWORK.....	59
2.4.1 Social learning	60
2.4.2 Organisational learning.....	65
2.4.3 Activity theory	68
2.4.4 Why not communities of practice?	74
2.4.5 Critical realism.....	76
2.5 CONCLUSION.....	81
3. CHAPTER THREE: STUDY APPROACH, DESIGN, METHODS AND ANALYSIS	83
3.1 INTRODUCTION	83
3.2 STUDY APPROACH	83
3.3 CASE STUDY RESEARCH DESIGN	84
3.3.1 Case study areas.....	88
3.4 STUDY METHODS	95
3.4.1 Document analysis method: study phase 1	95
3.4.2 Engagements with role-players: study phase 2	105

3.5 DATA ANALYSIS.....	116
3.5.1 <i>Analytic framework for document analysis: study phase 1</i>	<i>116</i>
3.5.2 <i>Role-player engagements data analysis: study phase 2.....</i>	<i>117</i>
3.5.3 <i>Activity system analytic lens and contradiction analysis</i>	<i>119</i>
3.5.4 <i>Retroductive analysis: study phase 3.....</i>	<i>123</i>
3.6 RESEARCH ETHICS	126
3.6.1 <i>Informed consent.....</i>	<i>126</i>
3.6.2 <i>Anonymity and confidentiality.....</i>	<i>126</i>
3.6.3 <i>Validity, credibility and trustworthiness</i>	<i>126</i>
3.6.4 <i>Reflexivity as a strategy for dealing with positionality.....</i>	<i>127</i>
3.6.5 <i>Information management</i>	<i>128</i>
3.7 CONCLUSION.....	129
 4. CHAPTER FOUR: DOCUMENT ANALYSIS	 130
4.1 INTRODUCTION.....	130
4.2 KEY DATA POINTS	130
4.2.1 <i>Key policy data points.....</i>	<i>130</i>
4.2.2 <i>Key institutional data points.....</i>	<i>133</i>
4.2.3 <i>Key operational data points</i>	<i>136</i>
4.2.4 <i>Findings: enablers and challenges</i>	<i>140</i>
4.3 ANALYTIC MEMOS	144
4.3.1 <i>Policy enablers.....</i>	<i>144</i>
4.3.2 <i>Policy challenges.....</i>	<i>146</i>
4.3.3 <i>Institutional enablers.....</i>	<i>147</i>
4.3.4 <i>Institutional challenges</i>	<i>148</i>
4.3.5 <i>Operational enablers.....</i>	<i>149</i>
4.3.6 <i>Operational challenges.....</i>	<i>150</i>
4.4 FINDINGS: ANALYTIC STATEMENTS	151
4.5 CONCLUSION.....	152
 5. CHAPTER FIVE: ROLE-PLAYER EXPERIENCES	 153
5.1 INTRODUCTION.....	153
5.2 ROLE-PLAYER ENGAGEMENT AT THE NATIONAL WETLAND INDABA CONFERENCE	154
5.3 SEMI-STRUCTURED INTERVIEWS DATA GENERATION	156
5.4 SEMI-STRUCTURED INTERVIEWS DATA POINTS AND ANALYSIS	157
5.4.1 <i>Lack of standardisation of RDM outputs</i>	<i>157</i>
5.4.2 <i>A platform needed for rectifying of errors.....</i>	<i>158</i>
5.4.3 <i>RDM outputs dissemination</i>	<i>159</i>
5.4.4 <i>Clarification of implementation roles and responsibilities.....</i>	<i>159</i>
5.4.5 <i>Transition to implementation actions</i>	<i>160</i>
5.4.6 <i>Need for functional technical tools.....</i>	<i>161</i>
5.4.7 <i>Data challenges.....</i>	<i>162</i>
5.4.8 <i>Recruitment of human resources and appointment of consultant teams</i>	<i>165</i>
5.4.9 <i>Capacity building</i>	<i>166</i>
5.4.10 <i>Stakeholder engagement</i>	<i>169</i>
5.4.11 <i>Partnership and cooperative governance.....</i>	<i>174</i>
5.4.12 <i>The RDM determination and implementation challenge.....</i>	<i>176</i>
5.4.13 <i>A more formal platform is needed for learning</i>	<i>182</i>
5.5 CHANGES IN ORGANISATIONAL PRACTICE ROLE-PLAYERS REGARDED AS EVIDENCE OF LEARNING	183
5.6 LESSONS FROM PREVIOUS PROJECTS CARRIED FORWARD IN CURRENT PROJECTS	184
5.7 WORKSHOP: IMPLEMENTATION OF RDM IN KWA-ZULU NATAL	186
5.7.1 <i>Workshop process</i>	<i>188</i>
5.7.2 <i>Workshop data points</i>	<i>192</i>
5.8 ROLE-PLAYER ENGAGEMENT SYMPOSIUM ON CAPACITY BUILDING	195
5.8.2 <i>Symposium data points</i>	<i>199</i>
5.9 ROLE-PLAYER ENGAGEMENTS FINDINGS.....	203

5.10 CONCLUSION.....	208
6. CHAPTER SIX: MAPPING ACTIVITY SYSTEMS AND CONTRADICTION ANALYSIS.....	209
6.1 INTRODUCTION.....	209
6.2 ACTIVITY SYSTEM ANALYTIC TOOL.....	209
6.2.1 Activity system mapping approach	210
6.3 MAPPING AND DESCRIPTION OF STUDY ACTIVITY SYSTEMS	214
6.3.1 Case study 1 selected activity system	214
6.3.2 Case study 2 and 3 selected activity systems.....	217
6.4 ACTIVITY SYSTEMS REVISED WITH ROLE-PLAYER INPUTS AND CONTRADICTION ANALYSIS	219
6.4.1 Case study 1: National Office RDM determination activity system	220
6.4.2 Case study 2: KwaZulu-Natal (KZN) Province RDM implementation	228
6.4.3 Case study 3: Mpumalanga Province RDM implementation	232
6.5 FINDINGS: ACTIVITY SYSTEMS CONTRADICTIONS AND INTERLINKAGES.....	237
6.5.1 Contradictions in the activity systems	237
6.5.2 Interlinkages of study activity systems	241
6.6 CONCLUSION.....	245
7. CHAPTER SEVEN: SYNTHESIS OF FINDINGS AND RECOMMENDATIONS	246
7.1 INTRODUCTION.....	246
7.2 EMERGING THEME IN THE POLICY CATEGORY.....	247
7.2.1 The challenge of providing some, for all, forever	247
7.3 EMERGING THEMES IN THE INSTITUTIONAL CATEGORY.....	254
7.3.1 Decentralisation	254
7.3.2 Resources: Tools, financial and human resources	258
7.3.3 The data challenge	264
7.4 EMERGING THEMES IN THE OPERATIONAL CATEGORY	266
7.4.1 The capacity building challenge	266
7.4.2 Stakeholder engagement	275
7.4.3 The RDM implementation challenge	282
7.5 CONCLUSION.....	293
8. CHAPTER EIGHT: CONCLUSION AND REFLECTION	294
8.1 INTRODUCTION.....	294
8.2 CONCLUSION.....	294
8.3 RESEARCHER REFLECTIONS	301
REFERENCES.....	304
Appendix 1: RDM Integrated Steps Framework	328
Appendix 2: History of RDM Projects in Water Management Areas.....	329
Appendix 3: South African Water Sector Institutional Landscape	331
Appendix 4: Roles and Responsibilities of Water Resource Management Institutions	332
Appendix 5: Participant Invitation, Interview Questions, Consent Form and Ethics Clearance Letter	334
Appendix 6: Role-Player Experiences on Activity Systems Factors and Preliminary Contradictions.....	341
Appendix 7: Role-Player Feedback and Experiences on Document Analysis Findings.....	345
Appendix 8: Role-Player Experiences on Learning.....	355
Appendix 9: Role-Player Experiences on Capacity Building	372
Appendix 10: Role-Player Experiences on Stakeholder Engagement.....	376
Appendix 11: Role-Player Experiences on Transitioning from RDM Determination to Implementation	379
Appendix 12: Role-Player Experiences on Implementation of RDM Outputs	386
Appendix 13: History of Decisions Post Development of New Water Policy.....	395
Appendix 14: Documents Data Samples (Inclusion Rationale and Snippets)	396

LIST OF FIGURES

Figure 1.1: Ecosystem services derived from healthy water ecosystems	2
Figure 1.2: Water use per sector in South Africa.....	4
Figure 1.3: NWA 36 of 1998 Chapter 3 water resource protection tools	11
Figure 1.4: The RDM approach in IWRM	12
Figure 1.5: An adaptive perspective for implementing RDM	13
Figure 1.6: Demarcation of six WMAs for South Africa	17
Figure 1.7: My career history in the South African water sector.....	19
Figure 2.1: Levels of capacity.....	44
Figure 2.2: South African water policy history	46
Figure 2.3: IWRM institutional role-players in South Africa	58
Figure 2.4: A CHAT second generation structure	69
Figure 2.5: Three levels of reality in critical realist ontology.....	79
Figure 3.1: Current structural composition of the DWS Chief Directorate Water Ecosystems Management – Case study 1.....	89
Figure 3.2: Old structural composition of the DWS Chief Directorate Water Ecosystems Management	89
Figure 3.3: The Mvoti to Umzimkulu WMA – Case study 2	92
Figure 3.4: The Inkomati WMA – Case study 3.....	94
Figure 3.5: Spectrum of extant data and elicited data	97
Figure 3.6: Inferencing approaches to exploring ontological depth.....	125
Figure 5.1: Researcher presentation at the National Wetlands Indaba conference	155
Figure 5.2: Role-player inputs following study presentation at the National Wetlands Indaba conference	155
Figure 5.3: KZN workshop invitation	186
Figure 5.4: Workshop welcome: Implementation of RDM in KZN Province.....	188
Figure 5.5: KZN workshop role-player engagement questions	189
Figure 5.6: KZN workshop groups during day 1 discussions	190
Figure 5.7: KZN workshop activity system inputs	191
Figure 5.8: KZN workshop day 2 group consolidation of discussions	192
Figure 5.9: IIE MSA symposium invitation	196
Figure 5.10: IIE MSA symposium programme	197
Figure 5.11: My presentation at IIE MSA symposium and participants.....	198
Figure 5.12: IIE MSA breakaway session focussed on capacity building	199

Figure 5.13: Discussion charts from the IIE MSA breakaway session on capacity building	199
Figure 5.14: IIE MSA breakaway session on creating awareness and discussion chart	202
Figure 6.1: National Office RDM determination activity system	215
Figure 6.2: Provincial office and CMA RDM implementation activity system	217
Figure 6.3: A more detailed version of the National Office RDM determination activity system following role-player inputs	220
Figure 6.4: KZN Provincial Office RDM implementation activity system with role-player inputs	229
Figure 6.5: Mpumalanga IUCMA RDM implementation activity system with role-player inputs	233
Figure 6.6: Mpumalanga Olifants Proto-CMA RDM implementation activity system with role-player inputs ..	235
Figure 6.7: Sub-activity systems embedded in the RDM determination activity	239
Figure 6.8: Interlinkages of study RDM activity systems	242
Figure 6.9: Activity systems embedded and interlinked to the RDM determination activity system	243
Figure 7.1: Essential capacity factors at each level including emerging study factors	271

LIST OF TABLES

Table 1.1: Water Management Area (WMA) boundary updates	16
Table 2.1: SDG 6 targets and indicators with direct relevance to water resource protection	36
Table 2.2: Description of Water Resource Classes	54
Table 2.3: Regulation 810 steps for RDM determination	55
Table 2.4: Summary of knowledge production practices	76
Table 3.1: Study design and methods.....	86
Table 3.2: Sourced documents, coding and description.....	99
Table 3.3: Role-Players interviewed per activity system	108
Table 3.4: Types of discursive manifestations of contradictions.....	120
Table 4.1: Summary of RDM determination and implementation enablers and challenges	140
Table 5.1: Implementation of RDM in KZN – workshop programme	187
Table 5.2: KZN workshop data points	193
Table 5.3: Capacity building breakaway session data points.....	200
Table 5.4: Summary of findings from role-player engagements during Phase 2	203
Table 6.1: Activity system mapping tool and analysis per activity system	211

ACRONYMS AND ABBREVIATIONS

APP	Annual Performance Plan
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
CSES	Complex Social-Ecological System
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DALRRD	Department of Agriculture, Land Reform and Rural Development
DBSA	Development Bank of Southern Africa
DFFE	Department of Forestry, Fisheries and Environment
DMRE	Department of Mineral Resources and Energy
DWA	Department of Water Affairs (former DWS)
DWAF	Department of Water Affairs and Forestry (former DWS)
DWS	Department of Water and Sanitation
EI4WS	Ecological Infrastructure for Water Security
EWR	Ecological Water Requirement
EWSETA	Energy and Water Sector Education and Training Authority
GEF	Global Environment Facility
IIE MSA	Independent Institute of Education Monash South Africa
IUA	Integrated Unit of Analysis
IUCMA	Inkomati-Usuthu Catchment Management Agency
IWQM	Integrated Water Quality Management
IWRM	Integrated Water Resource Management
KZN	KwaZulu-Natal
LGSETA	Local Government Sector Education and Training Authority
NBI	National Business Initiative
NEMA	National Environmental Management Act 107 of 1998
NFEPA	National Freshwater Ecosystem Priority Areas
NPC	National Planning Commission
NWA	National Water Act 36 of 1998
NWI	National Wetlands Indaba
NWRS	National Water Resource Strategy
NW&SMP	National Water and Sanitation Master Plan

NGOs	Non-Governmental Organisations
NSFAS	National Student Financial Aid Scheme
RDM	Resource Directed Measures
RQIS	Resource Quality Information Services
RQOs	Resource Quality Objectives
SACNASP	South African Council for Natural Scientific Professions
SALGA	South African Local Government Association
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SDC	Source Directed Control
SDGs	Sustainable Development Goals
SDM	Source Directed Measures
SSP	Sector Skills Plan
Stats SA	Statistics South Africa
UEIP	uMngeni Ecological Infrastructure Partnership
WDCS	Waste Discharge Charge System
WMA	Water Management Area
WRC	Water Research Commission
WRCS	Water Resource Classification System
WUA	Water User Association
WWF-SA	World Wide Fund for Nature, South Africa

THESIS CHAPTERS

1. CHAPTER ONE: STUDY INTRODUCTION AND SETTING

1.1 INTRODUCTION

In this chapter, I provide the research context premised on the importance of water in society worldwide, the need to protect water resources (rivers, wetlands, estuaries and lakes as examples) and their dependent ecosystems to secure the ecosystem goods and services they render. I then provide the research focus and objectives for this study which aim to explore the case of water resource protection through Resource Directed Measures (RDM) in a South African state organisation, the Department of Water and Sanitation (DWS) previously called the Department of Water Affairs (DWA) and before that the Department of Water Affairs and Forestry (DWAF). I introduce the study sites at DWS National Office level and two provincial areas in KwaZulu-Natal (KZN) and Mpumalanga Provinces. I provide the study motivation, centered around my professional career as a practitioner in water resource management which is a multi-faceted practice as highlighted in the various divisions of my journey detailed in Section 1.6. I provide my positionality as the researcher and conclude the chapter with an outline of the thesis structure.

1.2 RESEARCH CONTEXT AND HISTORICITY

1.2.1 The water security threat

Water security is achieved when there is reliable water supply (quantity), of suitable quality, for sustaining human and ecological well-being, and supporting various economic uses (United Nations Water, 2013). Hence, water security ought to be a priority for any nation. Water security is hindered by a range of impacts on water resources including over abstraction, pollution, land degradation, and climate change (Godden, Ison & Wallis, 2011). Water resource protection is a key sustainability priority given that water is a basic requirement for human wellbeing, ecological functioning and a key input in economic activities such as agriculture, power generation, mining and hospitality (Grey & Sadoff, 2007; Pienaar et al., 2021). Healthy, well-functioning water ecosystems are among the core elements to achieving water security due to their widely documented role in providing

valuable ecosystem services (goods and services) to human society (Jewitt et al., 2016; Skowno et al., 2019). Ecosystem services (see Figure 1.1) are defined as the benefits obtained by people from ecosystems, including provisioning services (such as food, water), regulating services (such as flood control, water purification), cultural services (such as recreational benefits), and supporting services (such as nutrient cycling) that maintain the conditions for life on earth (Skowno et al., 2019). The interlinkage between water resources, their aquatic ecosystems and human livelihoods forms the basis for a Complex Social-Ecological System (CSES; Kingsford, Biggs & Pollard, 2011). The complexity is inherent where ecological and social components interact closely with each other exhibiting complex interdependent behaviour (Berkes et al., 2003). An example is that the condition of land and how people use land can have impacts on water quality as diffuse (non-point) sources of pollution (Locke, 2024).

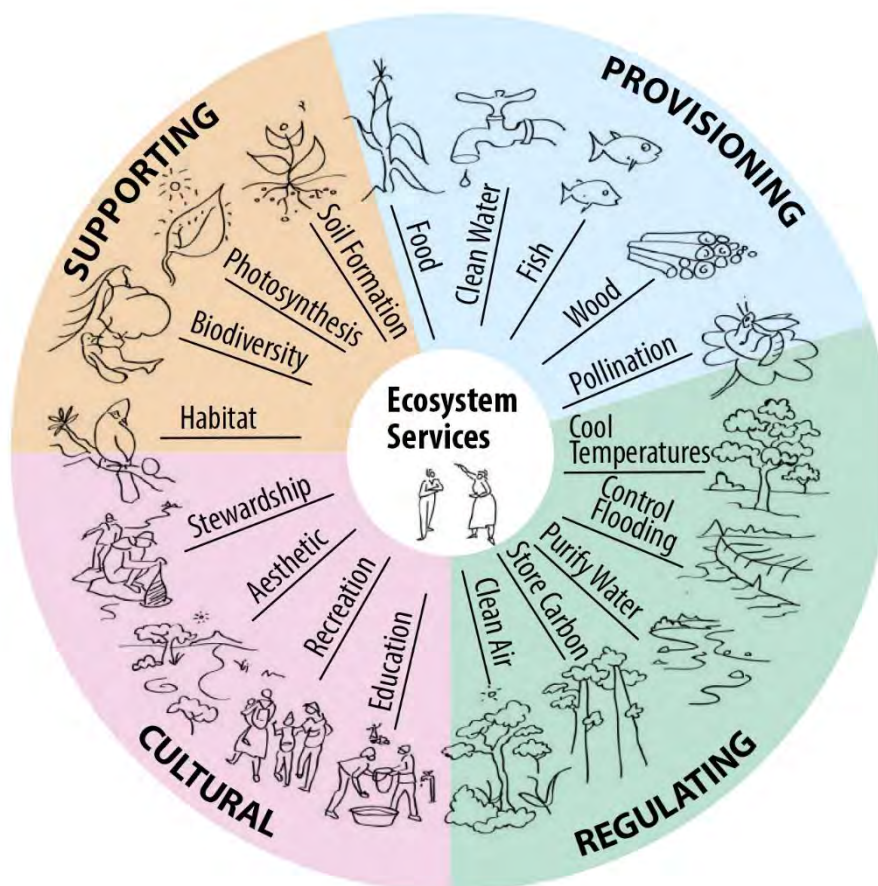


Figure 1.1: Ecosystem services derived from healthy water ecosystems

Source: Adapted from South Africa. Water Research Commission (WRC, 2018)

In South Africa, degradation of water ecosystems poses a risk to water security and socio-economic endeavours (Grey & Sadoff, 2007). While the country is regarded as having well-crafted legislation and policies for Integrated Water Resource Management (IWRM), shortcomings in implementation have been evident for some time (Claassen, 2013). Historically, approaches for management of natural resources have been found to be inadequate for dealing with challenges posed by complex, rapidly changing systems (Pollard & Du Toit, 2008, Holling, 2001; Folke et al., 2002). As a result, freshwater ecosystems are degraded, driven by anthropogenic activities, which affect hydrological flow regimes, water quality, geomorphology and subsequently habitat and biota; which are key interlinked characteristics of water courses and ecological health indicators whose degradation results in loss of critical biodiversity, and severely compromises the sustainability of water resources (South Africa. DWA, 2013).

More than a decade ago, 50% of South African river, wetland and estuary ecosystems were found to be threatened (Nel et al., 2011), while the majority of the remainder were also in a poor condition (Nel & Driver, 2015). The scale of degradation of these ecosystems was again quantified in recent years, indicating that estuaries comprise the highest overall proportion of threatened ecosystems (86%), followed by inland wetlands (79%) and rivers (64%) (Skowno et al., 2019). This has led to hydrological regime disruptions and deteriorating water quality (ibid.). The challenge is exacerbated by ecological infrastructure being largely treated as a free and infinite public good. Its economic value is seldom captured or quantified, nor does it receive sufficient investment (Angelstam et al., 2017). This situation poses a threat to water security in the country given the importance of water, outlined in Section 1.2.2. Moreover, Collins and Ison (2009) found that such situations that are characterised by complexity, uncertainty and multiple stakeholders, lead to controversy about the nature of the issues at hand and ways to address them; which illustrates the inadequacy of more conventional regulatory, fiscal or educative policy approaches.

1.2.2 Importance of water for all

Agriculture, power generation, industry and mining are globally among the high water use sectors, competing with domestic and environmental water needs; a situation which requires solutions to achieve water use efficiency for basic human needs, ecological functioning and to prevent business sustainability risks (Brandt, Johnson, Elphinston, & Ratnayaka, 2017; World Business Council for Sustainable Development, 2018). Figure 1.2 shows the proportionate water use per sector in South Africa.

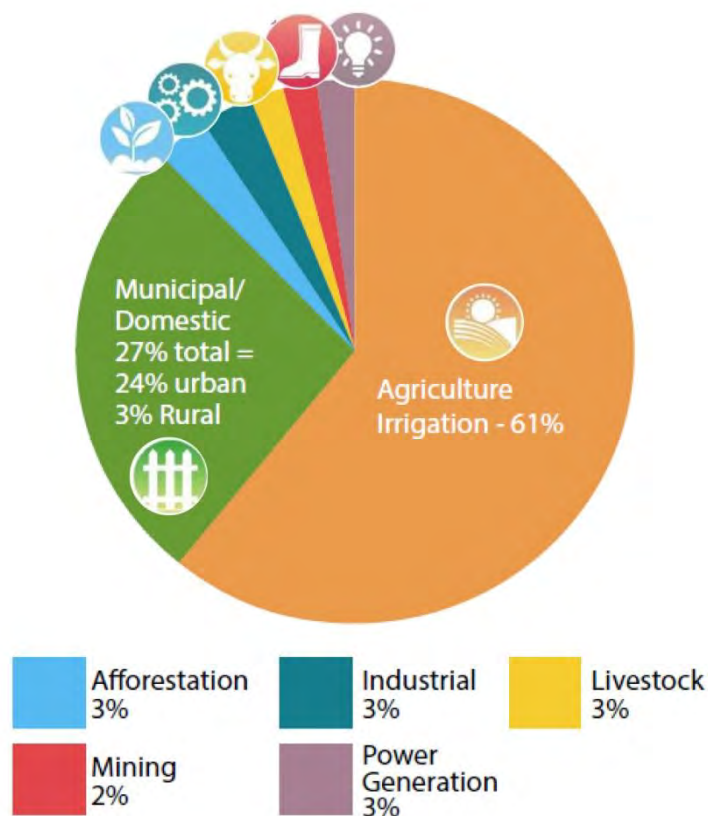


Figure 1.2: Water use per sector in South Africa

Source: Adapted from South Africa. DWS (2018, 2023)

The National Water and Sanitation Master Plan (NW&SMP) recognises the water crisis South Africa faces and attributes pressures on water resources to a variety of factors, including inadequate investment and maintenance of water infrastructure, droughts driven by climatic variation, deteriorating water quality and insufficient water quantities, and lack of skilled human resources for water resource management (South Africa. DWS, 2018). These identified challenges, particularly inadequate human capacity in water resource management, are of

interest in the current study, motivating the need for an exploration of learning and the rationale for reflection on skills and capacity in water resource management.

1.2.3 Skills and capacity constraints in water resource management

Capacity development as a concept emphasises the need to “build on what exists, to utilize and strengthen existing capacities, rather than to start from scratch” (United Nations Development Programme [UNDP], 1998, p. 6). It refers to the overall system, environment or context within which individuals, organisations and societies operate and interact (ibid.), thus extending beyond a single organisation.

Human capacity constraints are widely documented in the South African water sector (Swatuk, 2005; South Africa. Water Research Commission [WRC], 2007; Anderson, Karar & Farolfi, 2008; Colvin et al., 2008; Funke & Jacobs, 2011; Brown, 2014). The NW&SMP recognised skills constraints in the water sector as a risk to achieving IWRM (South Africa. DWS, 2018). This, coupled with “administrative failures and poor enforcement of regulations”, has been identified as eroding the country’s capability to manage water security risks (South Africa. National Planning Commission [NPC], 2012, p. 178).

Although South African policy is considered to be among the most progressive in the world, based on an IWRM approach; a decade after the introduction of the National Water Act 36 of 1998 (hereafter the NWA; South Africa, 1998), Colvin et al. (2008) outlined implementation challenges that face IWRM. The study (Colvin et al., 2008) illustrated that progressive policy is not always accompanied by progressive implementation, reporting significant delays in numerous areas of implementation, and noting that effective capacity building is required to support implementation. In addition, Rogers, Roux and Biggs (2000) highlighted the need for catchment implementation institutions¹ to have dedicated ecological expertise for ensuring ecosystem management.

¹ the terms ‘institution’ and ‘organisation’ are used interchangeably to refer to business entities playing a role in water resource management settings referred in the study case.

Highlighting the systemic nature of the challenge, Claassen (2011) observed that over the years the number of competent technicians working in water management and regulation at various government levels had decreased. While staff turnovers due to retirement and migration are inevitable, succession planning and mentoring programmes have been found to be inadequate (Claassen, 2011). Knowledge transfer measures implemented by authorities to replenish expertise were found to be ineffective (ibid.). At municipal level, skills shortage for the water services sector included engineering and other technical skills, health and hygiene practitioners, financial skills and strategic management and leadership; these skills shortages were found to be similar to those found in the water resources management sector (South Africa. WRC, 2007). The dwindling human capacity was also found to hamper efficient operation of water purification and wastewater treatment (Siddle & Koelble, 2016). More recently the Energy and Water Sector Education Training Authority (EWSETA) has identified priority occupations in their Sector Skills Plans (SSP), needed to strengthen water services, as Geohydrologist, Hydrologist, Water Process Controller, Water Quality Analyst, Hydraulic Power Controller, Water Inspector, Quality Manager, Water Plant Operator, Mechanical Engineer and Environmental Scientists, among others (EWSETA, 2019, 2021 & 2022). Water sector priority skills are also identified by the Local Government Sector Education and Training Authority (LGSETA, 2021) as Water Reticulation Practitioner, Civil Engineer, Environmental Scientists (encompassing Water Use Specialist and Environmental Officer), and Environmental Consultant/Advisor. Colvin et al. (2008) found that past capacity building approaches that were used by DWS were not successful, and they were characterised by one-way, expert-driven approaches. They recommended a more progressive approach that is based on an iterative, learning-by-doing approach to capacity building (ibid.). Initiatives such as the DWS Graduate Trainee programme and War on Leaks implemented in recent years have a capacity building dimension, however, their effectiveness is unknown.

As it has been known for decades that skills and human capacity constraints pose a challenge for water resource management, and yet the problem persists, it is important to establish what has been learnt in this regard through organisational learning (see Section 2.4.2), and it also seems important to look at this long-standing situation through a new lens.

1.2.4 The need for a new lens

As a ground-breaking policy, the NWA (South Africa, 1998) set up an unprecedented implementation challenge for which there was no blue-print. It is fair to say that implementation has not been optimal, as widely documented over several years (Claassen, 2013; Knüppe & Meissner, 2016; South Africa. DWS, 2018; Nepfumbada, 2020; Pienaar et al., 2021). This suggests that organisational learning is vital to support implementation of the NWA (South Africa, 1998) vision. Boreham and Morgan (2004, p. 308) postulate learning as organisational when it is “undertaken by members of an organisation to achieve organisational purposes, takes place in teams or other small groups, is distributed widely throughout the organisation and embeds its outcomes in the organisation's system, structures and culture”. Linking to the sociocultural approach of Argyris and Schön (1978), they described that in the process of organisational learning, an open communication and collaboration culture forms between the members of the organisation and in that process, they recognise, question and replace the previously hidden assumptions that underpin their current practice. Definitions of organisational learning (Boreham & Morgan, 2004; Argyris & Schön, 1978) highlight a need for collective effort to achieve organisational learning. This sociocultural theory is expanded in the work of Vygotsky (1978), Leont’ev (1978, 1981), Engeström (1987) and Engeström and Sannino (2010) providing a deeper interpretation of organisational learning within a work group where their knowledge and expertise is embodied in their artifacts which are significant constituents of the organisational culture and a means of communication (see Section 2.4.3).

Studies have recognised that governance practices are central to creating enabling institutional arrangements for learning and adaptation in dynamic and often uncertain contexts, such as water ecosystems, where uncertainties are exacerbated by climate change (Berkes & Folke 1998; Pollard & Du Toit 2011; Pollard, Riddell, Du Toit, Retief & Ison, 2023). Cockburn, Palmer, Biggs and Rosenberg (2018) urged that ongoing change, uncertainty, emergence and surprise which characterise the dynamic nature of CSES (described in Section 1.2.1) ought to be recognised.

Within CSES, the IWRM approach (detailed in Section 2.2.1) adopted in South Africa to balance water resource use for livelihoods with protection of the resource to conserve its functions for future generations, while promoting social equity, environmental sustainability and economic efficiency (South Africa. DWAF, 2004), is itself a complex undertaking, likely to require ongoing learning among stakeholders. Maheshwari, Ravi and Pillai (2004) defined stakeholders in water resource management projects as human and non-human entities who encompass individuals, ecological elements, entities who may be affected by the water resource project and who may in turn also influence the future course of the project. A stakeholder is anyone who has a stake in what happens, as explained by Wilcox (2003). They would subsequently embark on actively constructing, promoting and defending their stake through their engagement with an issue, their understanding and thus their stake may change, giving rise to new practices (Ison & Watson, 2007). Given the complex, social-ecological nature of water ecosystems, the kind of learning required to manage them and protection measures would need stakeholder engagement to span across disciplines and knowledge bases, hence social and organisational learning presented a promising approach for studying the complex problems of water resource management.

This current study proposes a new lens on the situation of supporting the vision of the NWA (South Africa, 1998), a sociocultural one, bringing the learning sciences to bear on the technical-engineering, social-ecological and political-economic challenges of water management. Thus, this study responds to calls for a paradigm shift from discipline driven approaches, commonly natural sciences and engineering, in the quest for more effective, sustainable natural resource management, to more inclusive inter- and transdisciplinary approaches that enable transformative social learning across disciplines and stakeholder groups (Rist, Chidambaranathan, Escobar, Wiesmann, & Zimmermann, 2007; Hirsch Hadorn, Pohl, & Bammer, 2010; Lang et al., 2012; Young et al., 2014; Roux, Nel, Cundill, O'Farrell, & Fabricius, 2017). According to Gibbons et al. (1994) there is a need for new specialisations, which drive discovery and innovation, and are problem-oriented and mostly transdisciplinary in character. A transdisciplinary approach to knowledge building could be valuable in water ecosystems management, due to the interconnectedness between water users, water

resources and the environment, and the need to efficiently balance between water resource protection and use.

This interconnectedness suggests the need for integration in water resource protection as a practice for management of a CSES, as well as a related lens for studying water resource management. Integration includes policy harmonisation and coordination across the water sector (including government departments) given the interconnectedness of different natural resources (Funke & Jacobs, 2011). In addition, “integration entails acknowledging and taking into account the diverse multi-actor landscape and consequent diverging interests and perceptions that make up the water allocation and land reform landscape in order to come to terms with the existence of multiple social and cultural norms that shape this landscape” (Funke & Jacobs, 2011, p. 83-84). Pollard, Du Toit and Biggs (2011) emphasised that in complex systems uncertainty is always an underlying factor and hence the need to manage them through a process of strategic adaptive management that embraces learning-by-doing. Thus, the learning sciences seem to be an important inclusion as an educational approach to studying water resource protection.

1.3 RESEARCH FOCUS

In South Africa, Resource Directed Measures (RDM) are among the water resource management tools prescribed by Chapter 3 of the NWA (South Africa, 1998), Part 1 to 3, as one of the measures that were introduced for water resource protection. This study focuses on RDM for water resource protection in South African water ecosystem management, a practice within the broader context of water resource management, described in Section 2.3.1.4.

As noted in Sections 1.2.2 and 1.2.3, factors relating to policy, governance and institutional arrangements, partnerships, and skills development have presented challenges for the implementation of RDM interventions to achieve water security (Holling, 2001; Folke et al., 2002; Colvin et al., 2008; Pollard & Du Toit, 2008; Claassen, 2013; Knüppe & Meissner, 2016; South Africa. DWS, 2018; Nepfumbada, 2020; Pienaar et al., 2021). As a result, a significant number of water ecosystems are in poor condition (see Section 1.2.1).

Why the focus on RDM? I argue that RDM is a pivotal point in the water resource management practice and a key part of IWRM in South Africa. Although I later unpack RDM in detail (see Section 2.3.1.4), a summary is provided here for context. Water resource protection through RDM involves, in essence, the determination of the level of protection that needs to be assigned to a particular water resource, based on science and stakeholder inputs, to achieve the quantity and quality needed to sustain basic human needs and ecosystem functioning. Essentially, as detailed in Sections 2.3.1.4 and 3.3.1.1, stakeholders including government officials, for example Scientists, Project Managers, Engineers, Environmental Officers, Catchment Managers, Scientists in consulting teams, water users and civil society are meant to work together to set a desired Class for the water resource, determine the Reserve (the quantity and quality of water that should always be available in the water resource for basic human needs and ecological needs) and related Resource Quality Objectives (RQOs; narrative and numerical goals relating to the quality and quantity of water resources), for monitoring the resource, and providing direction to resource managers on how the resource should be managed. The RDM are fundamental in guiding the issuing of water use licenses to users in various industries and are therefore a fundamental starting point to IWRM in South Africa.

Water resource management requires interaction between various institutions at different levels (for example national, provincial, municipal) and disciplines. In this study I postulate that learning and co-learning among water resource practitioners, in and across these organisations involved in RDM interventions and implemented over time, might offer solutions for adaptation and optimal future implementation. This study aims to provide insights into the extent to which such learning happens, and the extent to which it is utilised, to inform future initiatives, and help to better understand and address enduring challenges.

As part of water resource protection tools, Source Directed Measures (SDM) for pollution prevention are detailed in the NWA (South Africa, 1998) Chapter 3 Part 4, Section 19-20. Pienaar et al. (2021) explained that source directed control is another strategy for managing the impact of land-use activities on water resources through measures such as providing licenses for water use and waste disposal. Water use must be regulated to ensure water protection and ultimately sustainability (Pollard & Du Toit, 2008). Together, RDM and SDM as

NWA (South Africa, 1998) Chapter 3 tools, depicted in Figure 1.3, provide for the protection of water resources in relation to their use, development, conservation and management. These aim to manage the use of water resources in an efficient, sustainable, and equitable manner.

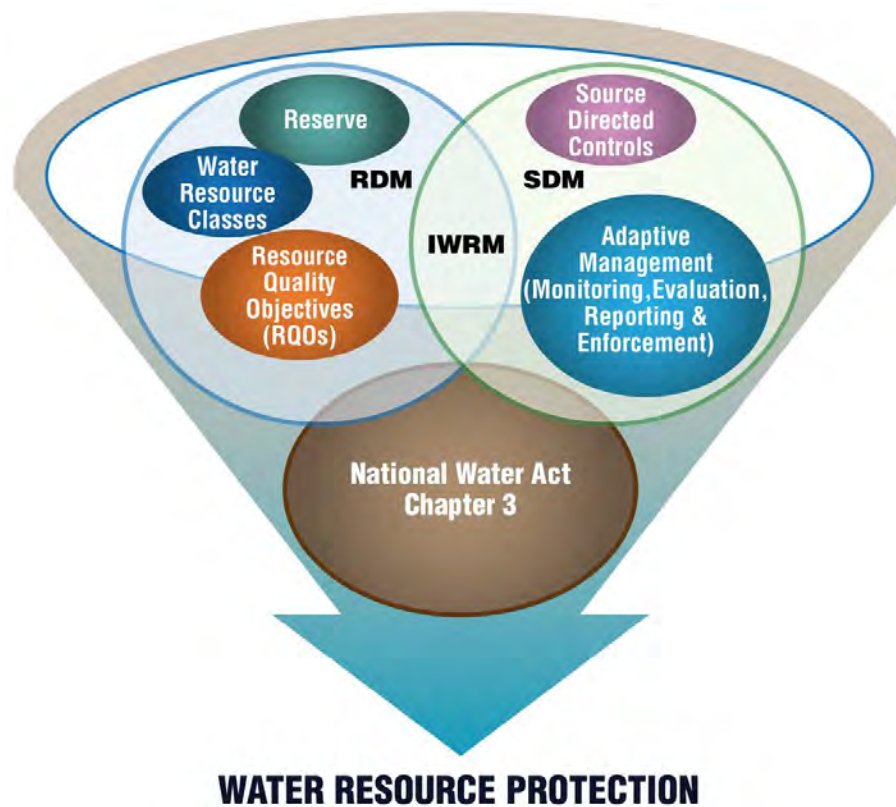


Figure 1.3: NWA 36 of 1998 Chapter 3 water resource protection tools

Source: Author

The RDM determination and implementation approach depicted in Figure 1.4 demonstrates the need for implementation of RDM in conjunction with SDM to ensure an integrated and balanced approach in consideration of the social, economic and environmental factors (Pienaar et al., 2021).

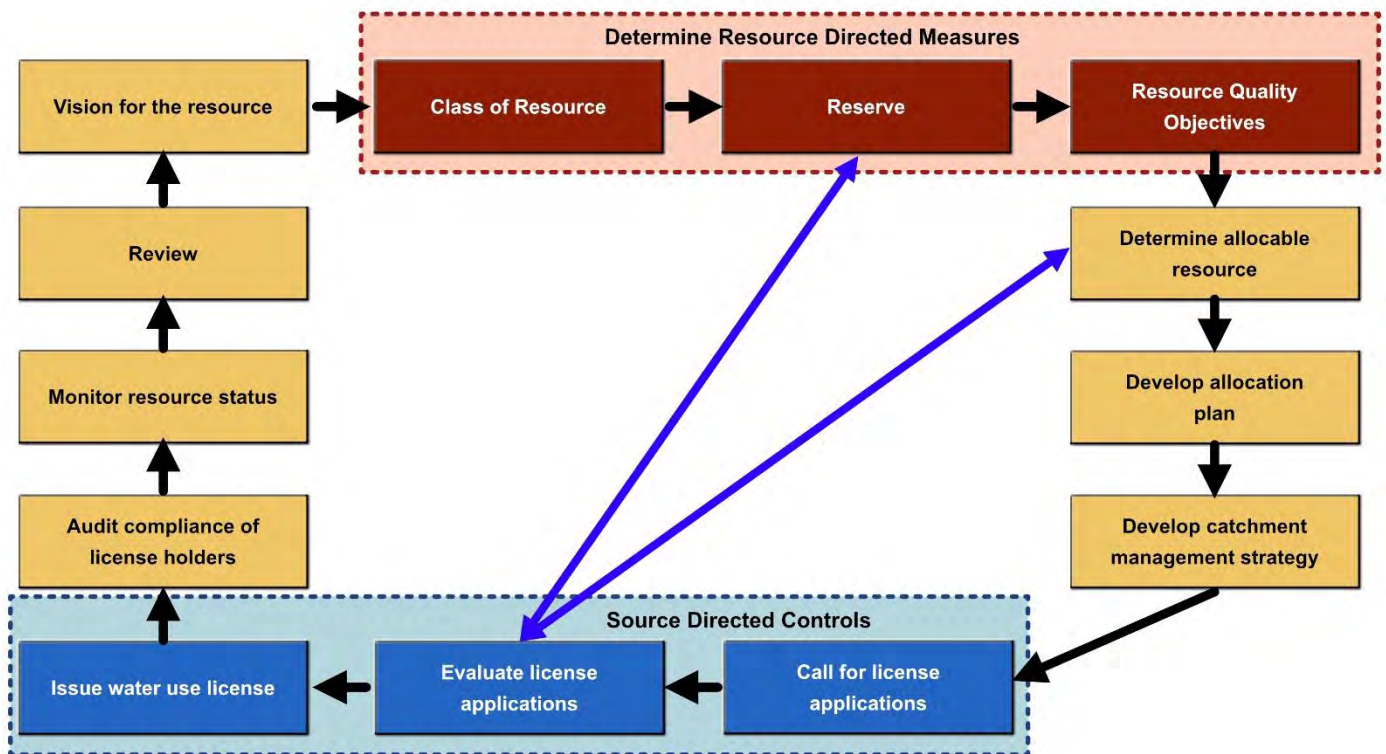


Figure 1.4: The RDM approach in IWRM

Source: Adapted from Pienaar et al. (2021)

Rogers, Roux and Biggs (2000) observed that the cyclic process in Figure 1.4 would appear iterative and potentially adaptive, they offered that incorporation of adaptive resource management as an alternative approach would take into account our limited understandings of ecosystem functioning, due to the continual state of flux of nature, and the importance of dealing with uncertainty from an imperfect knowledge base through learning-by-doing. They cautioned that operationally adopting a strategically adaptive process for managing water use and resource protection components would be challenging, requiring an iterative process (see Figure 1.5) of relating the current state of the water resource with the desired state; a hierarchical process for decomposing the water resource Class into achievable goals; parallel interactive strategies for the range of social, water use and protection catchment management activities; and integration of processes to continuously monitor resource status against protection goals and inform decisions for responding to changes in state (ibid.). Biggs and Rogers (2003) and Pollard et al. (2007) further asserted that the highly dynamic, uncertain, and evolving context in the country necessitates an adaptive and reflexive

approach that embraced learning and change. Rogers, Roux and Biggs (2000) proposed that an adaptive and reflexive approach would promote an iterative process for water ecosystem management and incorporate continued review of achievement of goals in the context of unexpected changes to the system, as depicted in Figure 1.5.

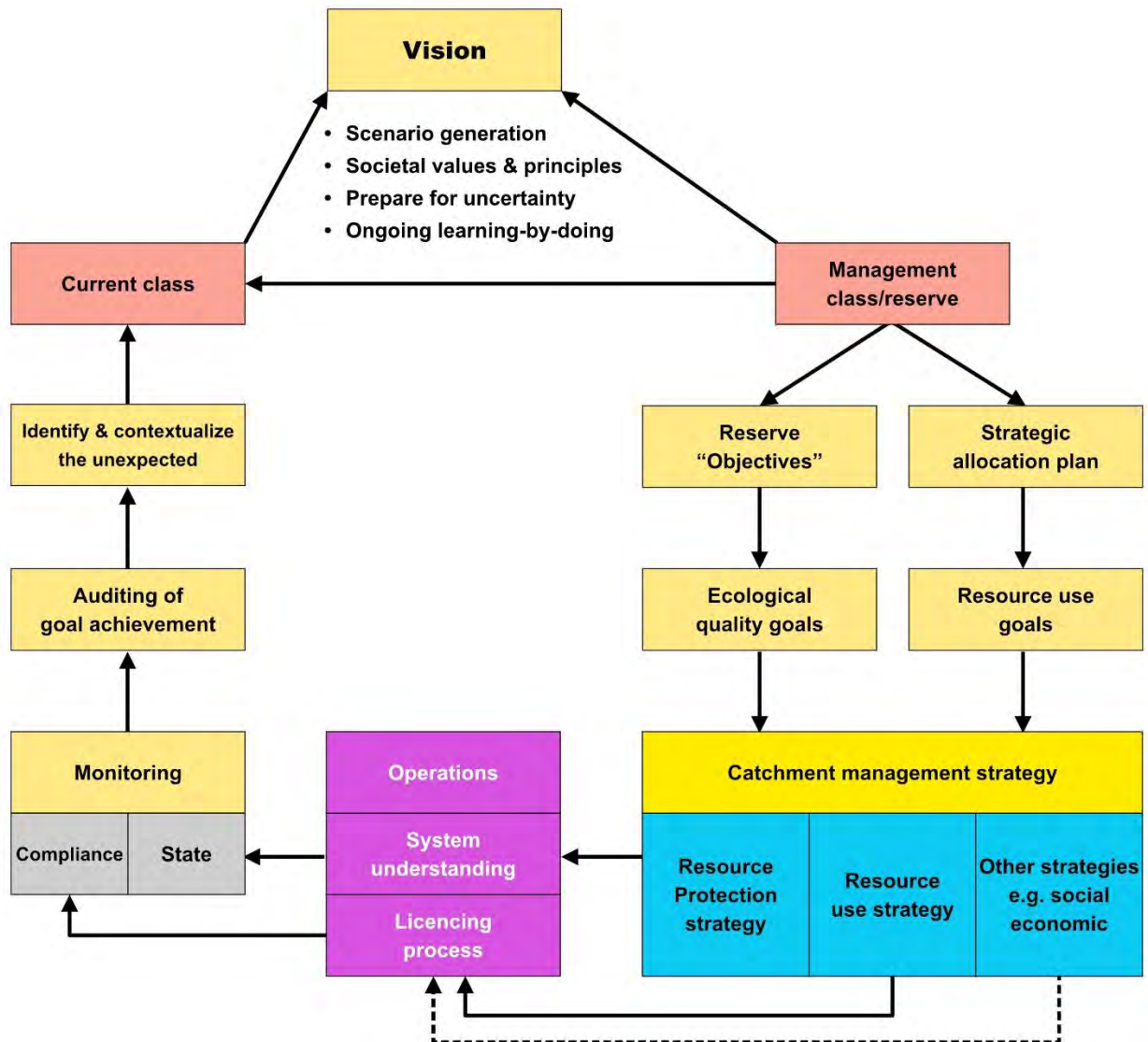


Figure 1.5: An adaptive perspective for implementing RDM

Source: Adapted from Rogers, Roux and Biggs (2000)

Various studies have been conducted on water ecosystems management and IWRM (Pollard & Du Toit, 2008; Kingsford, 2011; Pienaar et al., 2021). However, very few have focussed on the learnings of practitioners conducting this work. This study is based on my postulation that much can be learned from those working within water resource management institutions and

that surfacing these learnings through a socio-cultural learning lens can facilitate further co-learning towards a wider social learning process.

I chose a social-cultural learning lens (see Section 2.4.1) to explore the policy, institutional and implementation factors influencing RDM implementation and unearth related learnings already in the system regarding the well-documented challenges. The study focuses on identifying enablers and challenges for the implementation of RDM and learnings as reflected in the implementation experiences and insights of role-players involved in RDM over the past 10 years (2013 – 2023), during which RDM projects were commissioned in various catchments in South Africa. The term role-players in this study refers to practitioners in water resource management, chosen as research participants (see Table 3.3).

The study examined RDM initiatives (Water Resource Classes [also referred to as Classes], Reserve Determination, the setting of RQOs) in terms of determination and subsequent implementation. It sought to understand how water resource management practitioners, who undertake RDM determination and implementation, are learning in practice, if at all, and how this learning is taken up into organisational learning.

Bringing a social-cultural learning lens to the challenges of institutional water ecosystems management in the broader context of water resource management, I employed an activity systems theory framework, based on the work of Vygotsky (1978), Leont'ev (1978, 1981), Engeström (1987) and Engeström and Sannino (2010) including the latter's work on contradictions, as source points for learning in organisational systems, detailed in Section 2.4.3. The study is further underlaboured by critical realism (Bhaskar, 2008) (see Section 2.4.5). Bridges and Smith (2007, p. 2) explained that philosophy provides the "essential underpinning" or "underlabourer" of research in the social sciences. Similarly, Mukute (2010) found it useful to use critical realism as an underlabourer, providing the researcher with a tool to seek out deeper causal mechanisms that would otherwise have been missed. This is explained in Chapter 3.

1.4 RESEARCH AIM, OBJECTIVES AND QUESTIONS

The main aim of this research was to explore what new perspectives and learnings from RDM initiatives a social learning lens can unearth towards more sustainable water ecosystems management in South Africa. To address this research aim, I developed three research objectives, each linked to research questions as outlined below.

Objective 1: To identify enablers and challenges relating to policy, institutional and operational factors in the context of RDM. Linked research question:

- What are the policy, institutional and operational enablers and challenges for water ecosystems management through RDM implementation in South Africa?

Objective 2: To examine the implementation experiences of role-players and identify their associated learnings derived from participation in identified RDM interventions. Linked research question:

- What learning is evident from the experiences of role-players in the implementation of water ecosystem management through RDM?

Objective 3: To draw lessons and recommendations regarding organisational learning in the context of RDM policy implementation. Linked research question:

- What lessons and recommendations can be drawn from past RDM interventions for policy implementation, and overall organisational learning?

1.5 STUDY AREAS

In South Africa, water resources are managed according to geo-hydrological boundaries, known as Water Management Areas (WMAs), and not according to administrative boundaries of provincial and local government authorities (South Africa. DWAF, 2004). The NWA (South Africa, 1998), Section 1(1)(xxv), defines a WMA as an area, established as a management unit in the National Water Resource Strategy (NWRS). Each WMA is different, with different requirements for water resource management (South Africa. DWAF, 2004). These WMAs have been revised in NWRS documents since 2004. Table 1.1 provides the history of WMA revisions ('updates') and the WMAs for the selected case study areas.

Table 1.1: Water Management Area (WMA) boundary updates

	South Africa. DWAF (2004) Water Management Areas		South Africa. DWA (2013) Water Management Areas		South Africa. DWS (2023) Water Management Areas
1.	Limpopo	1.	Limpopo	1.	Limpopo-Olifants
2.	Luvuvhu and Letaba	2.	Olifants	2.	Inkomati-Usuthu
3.	Crocodile (West) and Marico	3.	Inkomati-Usuthu	3.	Pongola-Mtamvuna
4.	Olifants	4.	Pongola-Umzimkulu	4.	Vaal-Orange
5.	Inkomati	5.	Vaal	5.	Mzimvubu-Tsitsikamma
6.	Usutu to Mhlathuze	6.	Orange	6.	Breede-Olifants
7.	Thukela	7.	Mzimvubu-Tsitsikamma		
8.	Upper Vaal	8.	Breede-Gouritz		
9.	Middle Vaal	9.	Berg-Olifants		
10.	Lower Vaal				
11.	Mvoti to Umzimkulu				
12.	Mzimvubu to Keiskamma				
13.	Upper Orange				
14.	Lower Orange				
15.	Fish to Tsitsikamma				
16.	Gouritz				
17.	Olifants/Doorn				
18.	Breede				Case Study Area WMAs
19.	Berg				

Table 1.1 shows that 19 WMA demarcations were initially published in 2004 (South Africa. DWAF, 2004) and thereafter redefined into 9 WMAs published in 2013 (South Africa. DWA, 2013), and the latest 6 WMAs were published in 2023 (South Africa. DWS, 2023). This information is important because it details the WMA location of the selected case study areas and the revisions in their demarcation, over time.

For the purposes of describing the selected WMA case studies, the former (2004) WMA names and area descriptions are used to represent their state and demarcations at the time of RDM project execution and to align the case study names to the project names. Figure 1.6 depicts the geographical locations of the current six WMAs including the two within which the study case areas are situated.

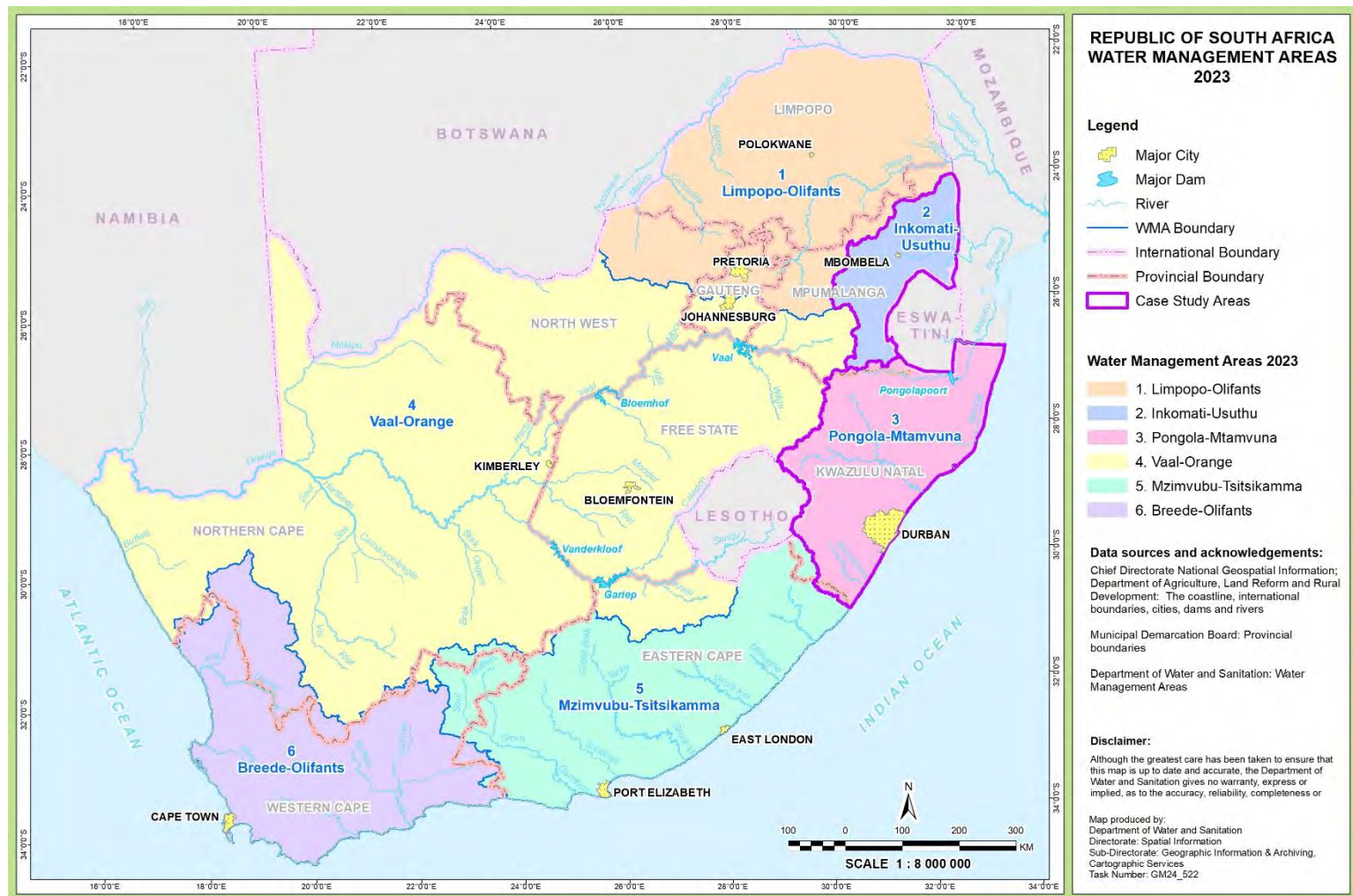


Figure 1.6: Demarcation of six WMAs for South Africa

Source: South Africa. DWS (2023)

The selected case studies for this research are detailed in Section 3.3.1 and mentioned here for introduction, namely the National Office RDM determination as case study 1, the KZN Province RDM implementation as case study 2, and the Mpumalanga Province Inkomati-Usuthu Catchment Management Agency (IUCMA) RDM implementation as case study 3.

1.6 STUDY MOTIVATION

Consideration of positionality and researcher interests is important for understanding the research motivation, approach and overall design (Greene, 2014; Milner, 2007). It is for this reason that it is important to provide a brief background of my career journey. My career history in the South African water sector motivated me to embark on this research study, inspired by my professional interest in water resource management. This interest, my prior learnings on my career journey thus far, my positionality as a registered Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP) in the Water Resources Science field of practice, and employment in the Department of Water and Sanitation (DWS), the national custodian of water resources, all played a key role in my choice of research topic, theoretical framework, methodological approaches and my interpretation of the study findings.

My journey in water resource management (see Figure 1.7) started in 2008, following my graduation with a Bachelor of Science, Honours degree in Microbiology at the University of Pretoria, and starting work as a Graduate Trainee at the DWS in the Resource Quality Information Services (RQIS) directorate.

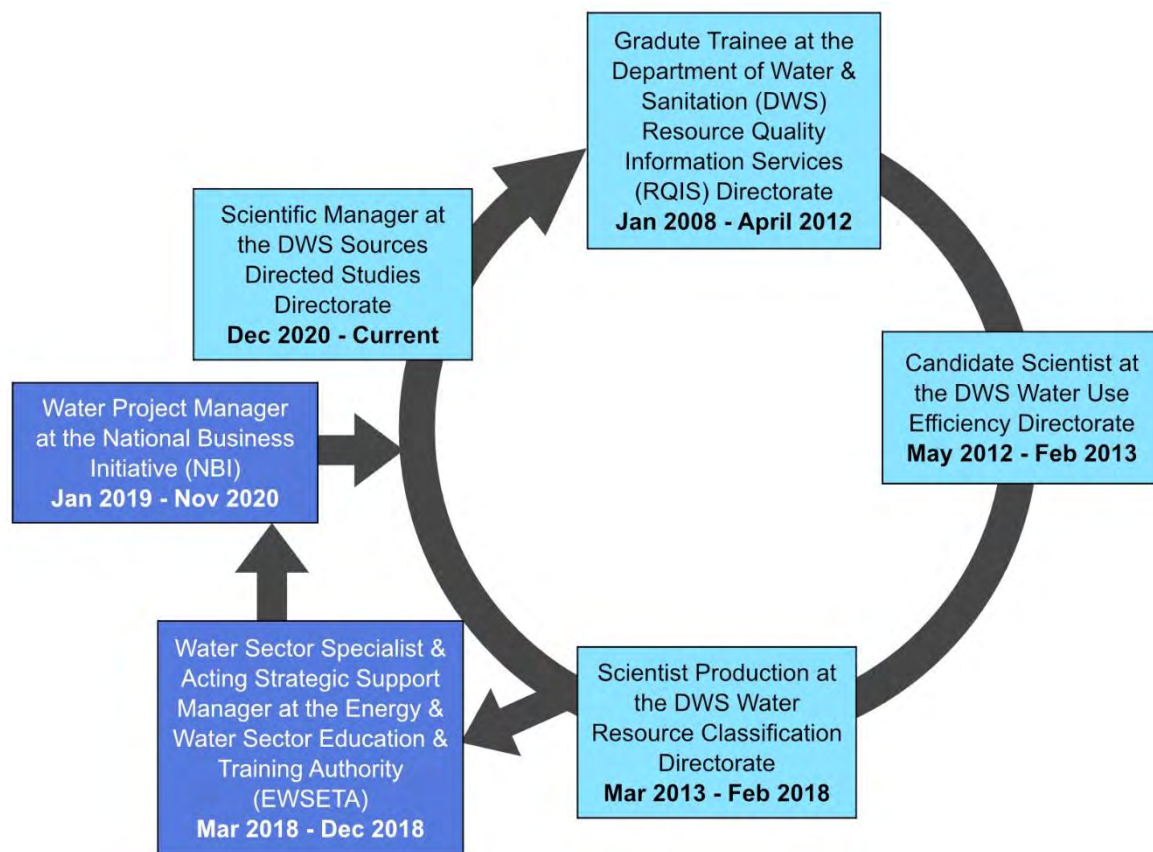


Figure 1.7: My career history in the South African water sector

Source: Author

The DWS Graduate Trainee Programme was aimed at scarce skills development and knowledge transfer through a mentor-mentee journey on-the-job training between an experienced staff member and a new staff member (South Africa. [DWS, 2023c], [DWA, 2013]). I worked full-time in water monitoring programmes and learned the practical basics of water resource management including sample collection, data analysis, report writing and evaluation of water quality trends. I also gained knowledge on river health monitoring and determination methodologies which would later frame the fundamentals of ecological status determination and how it factors into the methodologies for eco-classification.

Concurrently, I enrolled in a course-based, part-time Master of Science (MSc) degree in Water Resource Management, to help me better understand the field of work through modules such as Water Quality and Management, Water Conservation and Demand Management,

Environmental Change, Environmental Paradigms, Environmental Analysis, Assessment and Modeling, Environmental Law and research project, towards a mini-dissertation. Both my Water Resource Management course and the work I did at RQIS helped me appreciate river health and its role in the 'triple bottom line' (Elkington, 1998) of environmental (healthy catchments), economic (for example tourism) and social (provisioning ecosystem services) sustainability of our livelihoods.

After four years of on-the-job training and graduating with an MSc in Water Resource Management, I was registered by SACNASP as a Professional Natural Scientist. This led to a Candidate Scientist position in the DWS Water Use Efficiency Directorate where we worked with industries and the mining sector on water use efficiency strategies; followed by a Scientist Production post in the DWS Water Resource Classification Directorate, in the Chief Directorate Water Ecosystem Management in 2012. My work in this Directorate entailed management of water resource classification projects. This was where all the knowledge learnt from my work in the previous Directorates played a pivotal role in my understanding of the multi-faceted water resource protection work undertaken in Water Ecosystems Management Chief Directorate projects.

To build my project management expertise, in 2015, I enrolled for a part-time Masters in Business Administration (MBA) at the Tshwane University of Technology, where I completed a mini dissertation focused on water conservation. My initial journey with the DWS lasted ten years. In my final Scientist role, I was the Project Manager responsible for classifying significant water resources in the Mvoti-Umzimkulu Water Management Area (WMA), alongside the Rivers for Africa consulting team, DWS team members and project committees. This project sparked my curiosity on the implementation of these outcomes years later.

In 2018, I started a new role as a Water Sector Specialist at the EWSETA. Here I was exposed to the skills development challenges in the South African water sector. A year later, I took on the role of Water Project Manager at the National Business Initiative (NBI). My role at the NBI was to oversee the development and implementation of all water-related projects, manage stakeholder engagement, and provide strategic input and alignment of the water programme.

I worked in the NBI Kopano ya Metsi project, the uMhlathuze Water Stewardship Partnership and the Gauteng Water Alliance Initiative, all of which introduced me to action research and collective action by Non-Governmental Organisations (NGOs) in the South African water sector. A large portion of my work involved convening platforms for bringing together role-players from key water sector partner organisations for roundtable discussions and conferences. The NBI convened sector discussion platforms in collaboration with private sector companies and a variety of partners such as the DWS, diplomatic embassies, for example, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Netherlands Embassy, and other NGOs, among others, the World Wide Fund for Nature South Africa (WWF-SA) and the Strategic Water Partners Network (SWPN).

In my final role at the NBI, I was involved in a Global Environment Facility 6 (GEF 6) project led by the South African National Biodiversity Institute (SANBI), alongside the Development Bank of Southern Africa (DBSA) and the Department of Forestry, Fisheries and Environment (DFFE), and in collaboration with the Water Research Commission (WRC), NBI, Rhodes University Environmental Learning Research Centre (RU ELRC), WWF-SA, DWS, and other organisations. This Ecological Infrastructure for Water Security (EI4WS) project relates to this research study as it is intricately linked to RDM. It focuses on the implementation of biodiversity protection and restoration of ecological infrastructure in selected catchments, including, among others, the Umngeni Catchment in the KZN Province, which is one of the case study areas of this research study. This GEF 6 project is a collaboration across multiple organisations contributing to RDM implementation at catchment level. It was through my involvement in this project that I first encountered the work of the ELRC, which resonated with me, and led to my choice of academic institution for this study.

In December 2019, I rejoined the DWS as a Scientific Manager in the Directorate Sources Directed Studies (SDS), in the same Chief Directorate of Water Ecosystem Management as during my previous employment with DWS (see Figure 3.1). This was my place of employment at the time of writing this thesis.

In addition, growing up in a village near the town of Giyani in the Limpopo Province of South Africa, water shortage has been a lifetime challenge. I wondered from a young age what could be causing this issue. In those days 'water shedding' schedules, pipe bursts or water supply challenges were rarely explained or communicated by community leaders.

My career journey (Figure 1.7), combined with my personal, culturally diverse roots and multi-lingual identity, including Sepedi, Xitsonga, Tshivenda and IsiZulu, plays a pivotal role in my relational ease with stakeholders from various backgrounds, in my study and work environments. This background and experience provided for the development of a valuable quality for gaining access to diverse spaces and managing strategic partnerships, networks and programmes that are key components in IWRM.

Through this career pathway, I have gained work experience in water resource management through managing and co-ordinating multi-stakeholder projects, undertaken in collaboration with a variety of role-players, at multiple organisational levels, a journey that I continue walking. It is this journey that affords me the vantage point within the South African water sector and that has informed my desire to explore learnings of role-players within water ecosystems management units. It allowed me to reflect on what these role-players have learned, how they have come to learn, the mechanisms that enable such learning, and whether this learning penetrates the organisation to inform meaningful change.

In the first year of this study, I read several theories of social learning and ultimately settled on Cultural Historical Activity Theory (CHAT) as an interventionist theory for surfacing underlying contradictions, cognisant of the cultural and historical dimensions inherent in activity systems. The desire to dig deeper and surface the unknown about the already widely studied topic of water resource management led to my choice of critical realism as the underlabourer for the study.

The value of my career journey and prior lived experience offers me numerous vantage points, as a researcher in this case study. This, combined with my chosen theoretical framework puts me in a good position to gain new insights into the challenges in this study context, outlined next.

1.7 RESEARCHER POSITIONALITY IN THE SELECTED CASE STUDIES

1.7.1 Importance of positionality in qualitative research

Data generation is subjectively shaped by a researcher's interpretation. It is therefore important that positionality is considered upfront by the researcher because it can inform "the type of data that is gathered and how it is analyzed" (Greene, 2014, p. 2). I am passionate about the ideal of IWRM for environmental sustainability and contributing to water availability for people and nature. Positionality plays an important role because:

as qualitative researchers, what stories we are told, how they are relayed to us, and the narratives that we form and share with others are inevitably influenced by our position and experiences as a researcher in relation to our participants. This is particularly true for insider research, which is concerned with the study of one's own social group or society. (Greene, 2014, p. 1)

Insider research is conducted within a researcher's own social group where there are shared elements of common ground, for example, culture, race, language, gender (Greene, 2014; Merriam et al., 2001). The insider is, therefore, a researcher who possesses prior intimate knowledge of the community they are engaging as participants (Merton, 1972). The advantage is the ability to blend and gain access (Merriam et al., 2001), gaining participants' trust and respect through an earned status and acceptance (Dwyer & Buckle, 2009). This may aid with participants being more open, the researcher learning together with participants, and opportunities for the researcher to ask pertinent questions due to common understanding and shared emotions (Greene, 2014, p. 3-4). Therefore, the insider status can facilitate the generation of valuable data that may not otherwise be possible. As an example, Johnson-Bailey (1999, p. 669) found that between a researcher and participants of the same race and gender, "there were silent understandings, culture-bound phrases that did not need interpretation, and non-verbalized answers conveyed with hand gestures and facial expressions".

Some of the disadvantages of insider research, on the other hand, include a possible negative impact on relationships, if the researcher is privy to confidential information about the

research participants (Bell, 2005). This could make interviews uncomfortable and less informative. Furthermore, subjectivity may lead to the researcher making assumptions based on prior knowledge, and an inherent bias due to the close proximity of the researcher to the research context. This may in turn prevent the asking of provocative questions (Merriam et al., 2001). However, Greene (2014) asserts that insider researchers must not fear bias, they must be aware of it and take steps to eliminate errors it may bring to the research, while acknowledging that it might also bring unique insights.

Outsider research, on the other hand, is conducted by those who have little or no prior knowledge of the context under study. They are unfamiliar with the social group or culture involved and may be seen by the group to be too distanced to be trusted with sensitive information. This could present an access challenge (Greene, 2014). Regardless of the difference, both insider and outsider researchers must deal with similar methodological issues regarding positionality (Greene, 2014). Merriam et al. (2001, p. 405) argues that there exists a grey area of:

slippage and fluidity between these two states whereby not only will the researcher experience moments of being both insider and outsider, but that these positions are relative to the cultural values and norms of both the researcher and the participants.

According to Greene (2014), positionality in research talks to who one is in relation to the object of study. It calls for self-awareness in relation to the object of study, the extent to which a researcher is an insider or outsider in relation to the research context and how their positionality influences their access to information (Greene, 2014) and what they are able or unable to see (Milner, 2007). Therefore, my positionality in the selected study cases is outlined next.

1.7.2 Researcher's positionality in the selected case studies

In the identified case studies (see Sections 1.5 & 3.3.1), I feature as an insider for the RDM determination stage at the DWS National Office level, commonly known as head office, an insider/outsider for the RDM implementation stage at provincial office, also known as regional office, and an outsider for the RDM implementation stage at Catchment Management Agency (CMA) level. The National Office case study is focused on RDM determination for water resources protection. RDM determinations are conducted in the Water Ecosystems Chief Directorate, my current place of employment at the National Office of DWS. Therefore, in all the case studies I am an insider as a DWS employee in the RDM determination Water Ecosystems Chief Directorate. Moreover, I was the Project Manager for the KZN Province Mvoti to uMzimkulu RDM determination project (case study 2), which concluded in 2015, hence an insider at the determination level of this project. I have prior knowledge of the process when the KZN project was conducted and pre-existing relationships with various relevant stakeholders. I am an insider-outsider in case study 3 (Mpumalanga Province Inkomati RDM project). Although I work for DWS, I was not involved in the RDM determination process of case study 3. Fellow Project Managers, who are my current co-workers in the employ of the DWS, undertook that project.

All RDM outputs are implemented at provincial and catchment level water resource management. In both provincial case studies, I am an outsider at the implementation level, as I am based at head office and not the provincial office. However, the Mvoti project was undertaken with key provincial office personnel where I built relationships. In summary, I am an outsider in the KZN and Mpumalanga case studies (case study 2 and 3) at implementation stages. I provide a reflection on the impact of my positionality on this study in Chapter 8.

1.8 STUDY PHASES AND THESIS STRUCTURE

This study was conducted in three phases, aligned to the research objectives and questions detailed in Section 1.4. The phases are reflected in the thesis structure.

Phase 1 addressed objective 1, through:

- document analysis, to derive the study contextual profile, and the status quo of water ecosystems protection through RDM in South Africa, culminating in identifying enabling and challenging factors, categorised as policy, institutional and operational factors, and summarised in analytic memos;
- inductive and deductive analysis of data to identify enablers and challenges under each category as before; and
- mapping findings on the context, enablers and challenges into three preliminary activity systems, namely the National Office RDM determination activity system, the KZN Province RDM implementation activity system, and the Mpumalanga Province IUCMA RDM implementation activity system; and
- activity systems analysis to identify tensions and surface contradictions.

Phase 2 addressed objective 2, by:

- preparing Phase 1 information as mirror data to share with role-players, and to stimulate discussions, obtain reflections, inputs, and insights based on lived experiences in all three these activity systems;
- role-player engagement through 20 semi-structured interviews, one workshop, a symposium and post-presentation discussions at a conference;
- compiling interview questions based on the study objectives and drawing on the CHAT theoretical framework (Engeström & Sannino, 2010, 2011 and 2021);
- compiling and sharing back with role-players interview transcripts for review and further input;
- detailing each case and becoming intimately familiar with it for consolidation of data points and cross-case comparison (Cronin, 2014) and analysis of interviews and group discussions;

- inductive and deductive analysis of all data, emerging factors categorised into data themes;
- Revising preliminary activity systems with data from role-player experiences; and
- analysing role-player experiences data to identify manifestations of contradictions.

Phase 3 addressed objective 3, by:

- consolidating findings from all the above analytic frames and conducting retroductive (abductive) analysis of findings in critical realist generative mechanism analysis;
- deriving causal mechanisms underlying empirical findings; and
- consolidating all findings, causal mechanisms and drawing organisational lessons and recommendations per emerging theme.

The thesis was then written up using the structure below.

Chapter One: Introduction provided the study introduction which included an introduction to the study context and outlined the South African water history and status quo. The chapter also highlighted key challenges experienced in the water sector and provided motivation for a new, learning-focused lens on water resource management. The research focus, questions and objectives were presented followed by a brief introduction of the three study areas. The chapter also showed how my career journey led me to this research. Insights into my positionality within the overall study and the selected case areas were provided. The chapter concludes with this structure and outline of the thesis.

Chapter Two: Study Conceptual, Legislative, Institutional and Theoretical Frameworks, starts with global concepts relevant to the study contents including sustainability, IWRM, CSES, participation and capacity. Given the study setting in the South African water resource management, the relevant legislative and institutional frameworks are outlined. Given the study's social and educational science basis, the key concepts of learning, social learning, organisational learning and critical realism are presented in this chapter. The theoretical frameworks of CHAT are presented. Whereas some of the literature pertinent to this study has been included in Chapter 1, Chapter 2 serves as the main literature review for the thesis.

Chapter Three: Study Approach, Design, Methods and Analysis discusses the study approach, case study design and the methods used to generate data, namely document analysis and role-player engagement, through interviews, a workshop, a conference and a symposium. The research case study areas, institutional and operational landscapes are outlined. This chapter also covers the analytic frameworks used in data analysis, including second generation CHAT analysis, the activity system analytic lens and discursive manifestations of contradictions, critical realist modes of inferences including inductive and deductive analytic inferences and retroductive or abductive causal mechanism analysis. This chapter concludes with details on the study's ethical considerations and how they are addressed.

Chapter Four: Document Analysis presents the document analysis that was undertaken and its findings. This consists of a discussion of key data points relating to enablers and challenges across the study categories: policy, institutional and operational factors. This is followed by a presentation and discussion of the analytic memos and lastly, analytic statements as the summaries of the findings in this chapter.

Chapter Five: Role-Player Experiences provides the findings related to role-players' experiences, insights, reflections and inputs. This chapter presents the full spectrum of role-players' voices and displays the richness of data emanating from all engagements, including interviews, workshops and post conference presentation discussions.

Chapter Six: Mapping Activity Systems and Contradiction Analysis maps and describes each of the selected activity systems in the case studies, using CHAT's second generation analysis. The chapter then presents contradictions as evident in discursive manifestations. Primary, secondary and tertiary contradictions are identified across the activity systems.

Chapter Seven: Synthesis of Findings and Recommendations is a culmination of all the study findings presented in chapters four, five and six, presented in a framework that encompasses the study theoretical framework (CHAT) under each theme. It uses retroductive analysis to surface generative mechanisms that could be giving rise to the contradictions identified in

Chapter 6. The significance of findings for organisational learning are outlined per theme and recommendations are made, where relevant, within each theme. The chapter concludes with a presentation of expansive learning possibilities.

Chapter Eight: Conclusions and Reflections provides study conclusions based on all the findings and recommendations detailed in Chapter 7; and reflections on my experience on the study journey and insights into being an insider-outsider researcher.

2. CHAPTER TWO: LITERATURE REVIEW – STUDY CONCEPTUAL, LEGISLATIVE, INSTITUTIONAL, AND THEORETICAL FRAMEWORKS

2.1 INTRODUCTION

This chapter is an extension of the literature review in Chapter 1, and it is divided into five parts. The first part is the current introduction to the chapter. In the second part, I introduce global conceptual frameworks in water resource protection, within the broader practice of water resource management. Key interlinked concepts and terms discussed in the second part include Integrated Water Resource Management (IWRM), sustainability and its interlinkages to IWRM and governance, Complex Social-Ecological Systems (CSES), participation and capacity. As discussed in Section 1.2 and further observed in the interlinkages of these concepts in Section 2.2, the achievement of water security requires water resource management to be undertaken in a sustainable and integrated manner across a wide range of stakeholders and organisations.

In the third part, I discuss the South African legislative framework comprising of policies, strategies and guidelines relevant to water resource protection and the institutional framework. The fourth part details the conceptual frameworks regarding learning employed in this study, particularly, social learning and organisational learning. Lastly, in the fifth part, I discuss the associated theoretical frameworks of activity theory and Cultural Historical Activity Theory (CHAT) along with contradictions and expansive learning, as well as critical realism.

2.2 GLOBAL CONCEPTUAL FRAMEWORKS IN WATER RESOURCE PROTECTION

Water embodies ecological, social-cultural, economic, political and spiritual interests, and potential uses. Various approaches have risen aimed at bringing all catchment components, water resource users, managers and respective interests together for holistic consideration. These approaches include participatory integrated resources management and catchment-based resource management (Katusiime & Schütt, 2020) as well as Integrated Water Resources Management (IWRM) which is interlinked with sustainability, governance, CSES, participation and capacity, among others, as described next.

2.2.1 Integrated Water Resources Management (IWRM)

IWRM is defined as “a process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (Global Water Partnership [GWP], 2000, p. 22). Mitchell (2005) remarked that this GWP definition sets a high standard and also creates challenges related to the coordination of management initiatives for water, land, and related resources. The challenge includes the integration of water and land-based systems for management, planning and design and the related institutional arrangements in public agencies responsible for water and land management (ibid.). The picture that emerges is complex, with potentially conflicting objectives, likely to result in policy and implementation challenges (as noted in Section 1.2.1).

IWRM is driven by the understanding that water resources are an integral part of the ecosystem, a natural resource, but also a social and economic good. The United Nations Environment Programme (UNEP), through its United Nations Water (UN-Water) and partners lead global efforts for countries to report on the status of IWRM implementation. This was agreed at the World Summit on Sustainable Development in Johannesburg in 2002 and reinforced as Sustainable Development Goal (SDG) Target 6.5 (see Table 2.1) on IWRM and transboundary cooperation (United Nations Environment Programme [UNEP], 2023).

An enabling environment is a prerequisite for the implementation of IWRM. This refers to the national, provincial or local legislative instruments (policies, strategies) and management instruments (guidelines, institutional framework) that enable all stakeholders to play their respective roles in the development and management of water resources (Global Water Partnership [GWP], 2000). The GWP (2000, p13-14) outlined Dublin principles for water management as:

- (a) Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment;
- (b) Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels;

- (c) Women play a central part in the provision, management and safeguarding of water;
- (d) Water has an economic value in all its competing uses and should be recognized as an economic good as well as a social good.

These four principles to guide IWRM highlight the key issues of water management (Solanes & Gonzalez-Villarreal, 1999) and follow the recommendations of the United Nations Conference on Environment and Development Agenda 21 of 1992 (GWP, 2000). Although IWRM and water governance concepts are related, they cannot be used interchangeably (Allan and Rieu-Clarke, 2010). Definitions of water governance have been found to be fuzzy with common inconsistencies in usage and interpretations (Lautze, de Silva, Giordano & Sanford, 2011). Tropp (2007) made the link that the concept of IWRM ensued from the desire to transform and improve water governance through facilitating inclusive decision-making processes, coordination and negotiated outcomes, motivating the need for additional sociocratic knowledge and capacity development that, for example, puts the emphasis on the management of people and processes, diversity of organisational entities and knowledge sharing among them.

Lautze, de Silva, Giordano and Sanford (2011) assert that IWRM principles inform interpretations of water governance and notions of good water governance. IWRM is prescriptive in nature, largely comprised by pre-defined outcome goals. Governance, on the other hand, is focused on the processes that are used to decide what the goals are. Thus, water governance consists of the processes and institutions by which decisions that affect water management are made. Key elements of good water governance are deemed to include openness and transparency; broad participation; rule of law (predictability); accountability and ethics, including integrity (Lautze, de Silva, Giordano & Sanford, 2011). However, Allan and Rieu-Clarke (2010) found that these key elements by themselves are not sufficient to support IWRM unless the governance regime addresses the access points between them.

Allan and Rieu-Clarke (2010) caution that good governance will not by itself deliver what IWRM demands unless certain actions are legislated. This implies that for equity to be reliably achieved, disadvantaged and under-represented groups must be explicitly protected legally.

In addition, silent interests such as biodiversity and ecological processes will require specific legal provision with respect to both prescriptive regulation, market-based instruments, and mechanisms for ensuring that experience is fed back into the policy development sphere (Allan & Rieu-Clarke, 2010). These authors emphasised that this is heavily dependent on suitable legal provisions in relation to participation, legislative and constitutional processes and scientific evidentiary standards (ibid.).

This implies that addressing the symptoms of inadequate water resource management and degradation of water resources is futile unless addressing the root causes on the governance side. Katusiime and Schütt (2020) attribute these symptoms to unequal power balances, unfair use or allocation patterns between and within countries, and deficits in democratisation. Similarly, Godden, Ison and Wallis (2011) recognised a growing acknowledgement that constraints to achieving adaptive and sustainable water management may not be so much in the deficiencies of scientific or technical understanding of water resources, even given climate change, but in a failure to recognise the complexities of institutional, social and cultural aspects in water governance. Therefore, solving water management challenges also requires addressing water resources governance. The IWRM approach deals with water governance *and* water management, which differ conceptually but are interrelated.

The South African water resources management framework adopted the international principles of IWRM (South Africa. Water Research Commission [WRC], 2014). These take into account the various users and uses of water, to promote positive social, economic and environmental impact at all levels, including the transboundary level, where appropriate. The principles of IWRM are enshrined and implicit in the National Water Act 36 of 1998 (hereafter the NWA; South Africa, 1998, p. 3), which recognises “the need for the integrated management of all aspects of water resources”.

The linkage of IWRM to sustainability and SDGs has been made by UNEP (UNEP, 2023). The SDG Target 6.5 (see Table 2.1) aims to implement IWRM at all levels through two key components selected for the South African context, highlighted in indicator 6.5.1 and 6.5.2

(Statistics South Africa [Stats SA], 2023). In essence, these components provide an IWRM framework through defining the enabling environment (policies, legislation and regulations), institutional roles and functions, financing and management instruments aligned to those previously identified by Claassen (2013).

In 2015, 193 countries adopted the 2030 Agenda for Sustainable Development (hereafter Agenda 2030) as a framework to guide global development for the subsequent fifteen years. South Africa was one of the early supporters of this Agenda 2030. Sustainability forms a central theme in South Africa's National Development Plan (NDP) goals (South Africa. National Planning Commission [NPC], 2012) which are aligned to the Sustainable Development Goals (SDGs) (United Nations [UN], 2012; Stats SA, 2023).

2.2.2 Sustainability

Sustainable development was defined by the 1987 Brundtland Commission as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987). Since then, various definitions have been reported for different sectors that strive towards sustainability in diverse ways, including the water sector, where sustainability features in definitions of IWRM.

Based on the GWP (2000) definition, IWRM is founded on equity and sustainability as two key objectives. According to Allan and Rieu-Clarke (2010), equity refers to an allocation that takes into account all relevant factors and circumstances in order to derive the maximum benefit for all, whilst minimising the resultant harm, in the context of IWRM; while sustainability is the demand for ecosystem protection and maintenance of the long-term viability of the resource for present and future generations. These authors therefore conclude that sustainability could be seen as part of equity as it relates to intergenerational equity, and the balancing of interests between economic, social and environmental interests (ibid.).

Allan and Rieu-Clarke (2010, p. 244) highlighted the interlinkage between IWRM and sustainability, indicating that, IWRM seeks to manage catchments “so that economic, social and environmental concerns are balanced appropriately in decision making, in such a way as

to ensure that the twin aims of equity and sustainability are achieved". This balance effectively demands institutional coordination, both vertically and horizontally, across relevant resource management, political and sectoral interests; integrated management, at the basin level, of land, resource exploitation and waters, whether upstream, downstream, ground or surface; and the participation of all relevant stakeholders in decision-making that affects water quality, quantity and flow (GWP, 2000; Rieu-Clarke, 2010). The success or failure of IWRM in a national context depends on the quality of the governance as indicated by Allan and Rieu-Clarke (2010), this is attributed to the observations that "IWRM is not applied in a vacuum and the broader picture, as described by governance, provides the context in which the IWRM approach can be applied" (Rogers & Hall, 2003, p. 30), although the exact nature of this reliance is not clear.

In South Africa, the National Environmental Management Act 107 of 1998 (hereafter the NEMA; South Africa, 1998b) defines sustainable development as "the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations". NEMA (South Africa, 1998b), further, provides that sustainable development requires the consideration of all relevant factors including that:

- (a) the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- (b) pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- (c) negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.

Sustainability of water resources means meeting water security aspirations and needs of current and future generations (South Africa. WRC, 1996). To this end, SDG 6 which refers to "clean water and sanitation" and seeks to ensure the availability and sustainable management of water and sanitation for all by 2030 is the most relevant to this current study

(Stats SA, 2023, p. 96). Table 2.1 provides a summary of the targets of SDG 6, with direct relevance to this study.

Table 2.1: SDG 6 targets and indicators with direct relevance to water resource protection

Source: Stats SA (2019, 2023); South Africa. DWS, 2023b

SDG 6: CLEAN WATER AND SANITATION Ensure availability and sustainable management of water and sanitation for all
SDG TARGET 6.3: WATER QUALITY AND WASTEWATER
By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
Indicator 6.3.1D: Proportion of water containing waste safely treated and lawfully discharged. Indicator 6.3.2D: Proportion of bodies of water that comply with South African water quality objectives. Indicator 6.3.3A: Proportion of water containing waste recycled or reused. Indicator 6.3.4A: Proportion of waste lawfully disposed of. Indicator 6.3.5A: Proportion of waste recycled or reused.
SDG TARGET 6.5: WATER RESOURCES MANAGEMENT
By 2030, implement integrated water resource management at all levels, including through transboundary cooperation as appropriate.
Indicator 6.5.1: Degree of integrated water resources management implementation (0 - 100). Indicator 6.5.2: Proportion of transboundary basin area with an operational arrangement for water cooperation.
SDG TARGET 6.6: WATER-RELATED ECOSYSTEMS
By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
Indicator 6.6.1D(1): Extent in the spatial extent of water related ecosystems over time, including wetlands, reservoirs, lakes and estuaries as a percentage of total land area. Indicator 6.6.1D(2): Number of systems affected by high trophic and turbidity states. Indicator 6.6.1D(3): Change in the national discharge of rivers and estuaries over time. Indicator 6.6.1A(1): Change in the ecological condition of rivers, estuaries, lakes and wetlands.

To ensure sustainability of *SDG 6 clean water and sanitation*, Agenda 2030 calls for signatory countries to conduct regular monitoring of set indicators, and for the reporting on a three-yearly basis to the United Nations (UN). Table 2.1 provides a summary of water related SDG indicators for South Africa, customised for the country context and annotated in the table with *D* for *Domestic* and *A* for *Additional*. Where neither *D* nor *A* is denoted, the global indicator wording was retained as proposed by the UN and adopted without change for South

Africa. The SDG's make the link that healthy water resources are required from both a security and development point of view.

Environmental health is connected with socio-economic wellbeing where healthy water ecosystems render ecosystem goods and services (Mitchell, 2005). Given this context, sustainable and integrated water resource management is thus an ambitious undertaking, expected to be challenging in water resource protection, due to the intricate balance needed between the use of water resources for livelihood and their protection for conservation of the resource, to sustain its functions and characteristics. In addition, as noted in Section 1.2.4, the context within which water and land management ought to be undertaken is complex given the diverse multi-actor landscape (see Sections 2.2.3 & 2.3.2) shaped by consequent diverging multiple social and cultural norms, interests and perceptions as explained by Funke and Jacobs (2011).

2.2.3 Complex Social-Ecological System (CSES)

A framework to study the intertwined human and natural systems as Social-Ecological Systems (SES) was developed by Berkes and Folke (1998). These authors sought to study the dynamics of institutions in relation to the dynamics of ecosystems for both social-ecological resilience and improved performance. Janssen and Ostrom (2006) posit that social-ecological systems are complex adaptive systems where social and biophysical agents are interacting at multiple temporal and spatial scales. According to Colding and Barthel (2019), ecological knowledge and understanding is a critical link between complex and dynamic ecosystems, adaptive management practices, and institutions, and the connection between ecological and institutional systems rely as much on scientific knowledge, as on the ecological knowledge held by local users. The SES framework (Berkes & Folke, 1998) focuses on local management systems that are able to maintain institutional and ecological resilience in local settings, rather than top-down, command-and-control resource management systems (Colding and Barthel 2019).

According to Angelstam et al. (2013), sustainable development in SES focusses on links between social and ecological systems, and emphasises reciprocal interactions and feedbacks

within-scale and cross-scale, between these systems. In support of this observation, Cockburn et al. (2020) found that working in multi-actor natural resource management such as landscape stewardship required relational approaches that embraced the characteristic of such systems as Complex Social-Ecological Systems (CSES). Given the current risks and uncertainties in Resource Directed Measures (RDM) for water resource protection in South African water ecosystems management, outlined in Section 1.2.1, and exacerbated by climate change, adaptive governance that embraces the inherent complexity of landscapes as SES is required. This research study recognised that the system is in some ways constantly changing, hence dynamic. This dynamic and complex nature of environmental problems such as water ecosystems management requires flexible and transparent decision-making that also embraces a diversity of knowledges and values (Reed, 2008). Thus, stakeholder engagement is key for ensuring participatory processes, discussed next.

2.2.4 Participation

Sigalla, Tumbo and Joseph, (2021) asserted that water-related problems are interlinked and can only be solved by interactions among diverse disciplines and stakeholders under the auspices of IWRM in multi-stakeholder platforms. These platforms are aimed at bringing together government, civil society, and the private sector to address complex development challenges that no one party alone has the capacity, resources, and know-how to do so more effectively (*ibid.*). Therefore, participation of diverse stakeholders (as defined in Section 1.2.4) has been identified as an essential part of sustainable water resources management.

The importance of stakeholder participation in water resource management processes is well established in literature and legislation worldwide. Internationally, resolutions of the United Nations Conference on Environment and Development (UNCED, also known as the Earth Summit) in Rio in 1992 emphasized the need for public involvement in the design and implementation of all sorts of environmental policy; and their participation captured in Principle 10 which specifies that environmental issues are best handled with participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public

authorities and the opportunity to participate in decision-making processes (United Nations, 1992).

Stakeholder participation is defined as a process where individuals, groups and organisations choose to take an active role in making decisions that affect them (Reed, 2008). It aims to ensure that beneficiaries and interested groups are actively engaged in decision-making processes and their views are taken into account in the final outcome (Allan & Rieu-Clarke, 2010). Stakeholder engagement as early as possible in decision-making processes has been found to be essential for ensuring participatory processes lead to high quality and durable decisions (Reed, Fraser & Dougill, 2006; Reed, 2008). Stakeholder participation is notably different from public participation which aims at involving the broader public in decision making (Rowe and Frewer, 2000; Reed, 2008). In this study, stakeholder participation or consultation or engagement are used interchangeably.

Different levels of participation are appropriate for different situations depending on the nature of participation (Wilcox, 2003). Levels of participation were originally described in Arnstein's eight-step ladder of participation ranging from passive dissemination of information to active engagement (Arnstein, 1969) and subsequently altered by Wilcox (2003) into five levels including information, consultation, deciding together, acting together and supporting independent community interests. Farrington (1998) distinguished according to the degrees of stakeholder engagement and described participation that is consultative, functional or empowering. Subsequent to these views, various forms of participation have been proposed including transformative participation where the process changes meaning, power or social formation (Lawrence, 2006), while Rowe and Frewer (2000) focused on differentiating the nature of engagement varying from communication (information dissemination to passive recipients or top-down communication and one-way flow of information) as the lowest level, to consultation (gathering information from participants), and participation (two-way communication between participants where information is exchanged forms such as dialogue or negotiation) as the highest level. Lynam, De Jong, Sheil, Kusumanto and Evans (2007) opted for types of participation based on the objectives of participation and differentiated between diagnostic and informing, co-learning or co-management methods. Other authors have

offered various alternatives. In essence, each type of participation offers an alternative basis for distinguishing between various available methods and approaches for stakeholder participation and present the various methods available for selection depending on the purpose of the work in a given context (Reed, 2008). In concurrence, Stringer et al. (2006) found that participation takes many forms and can occur at different stages of the adaptive process; however, meaningful participatory processes involve social learning and an exchange of information between stakeholders that is linked to management decisions. In addition, Ison and Watson (2007) explain that facilitation in the form of seminars or workshops, personal contacts and web reporting can be used to activity build stakeholding (defined in Section 1.2.4). Facilitation is a key element for ensuring stakeholders have the capacity to participate meaningfully.

In South Africa, according to the NWA (South Africa, 1998, p. 24), once a Catchment Management Agency (CMA) is developed, establishment of a Catchment Management Strategy must “enable the public to participate in managing the water resources within its WMA”. Moreover, there is generally consensus among different stakeholders (policy makers, researchers and water managers) in water management that IWRM must be done at the level of the catchment as a key aspect of decentralisation (Ashton, Turton & Roux, 2006; Pollard & Du Toit, 2008; DWS, 2023). Establishment of CMAs was envisaged to set the stage for the participation of civil society and decentralized water resources management (Schreiner & Hassan, 2010). However, establishment of CMAs has been challenging due to institutional arrangement challenges deemed to undermine water resource management progress at catchment level (Nepfumbada, 2020). According to Du Toit (2005), there is generally a gap between expectations and opportunities among participants in a public participation process in South Africa due to poor public awareness campaigns in the current democratic dispensation which has shifted all responsibilities to the government. In addition, policies and legislation on public participation processes in South Africa are silent on how best public involvement can be achieved (ibid.).

Policies for DWS’ water resource management mandate, including those for water ecosystems management (see Section 2.3.1.3), are committed to public participation.

However, DWAF (South Africa. DWAF, 2001) recognised that these policies did not prescribe either the extent of public participation nor how to achieve it. In light of this gap, stakeholder engagement guidelines were developed to assist DWS officials in public participation and decision-making processes. In alignment with the global understanding, DWAF (South Africa. DWAF, 2001) identified 16 principles that underpin public participation, including inclusive involvement of stakeholders, integration, mutual respect among role-players, continuity in participation, consideration of multiple options, flexibility, transparency, rights and roles, accountability and commitment, accessibility of information, awareness creation, capacity building and empowerment, efficiency, suitability of scale of involvement, feedback, monitoring and evaluation (ibid.). These principles cut across all the typologies of participation, such as those based on objectives, structure, function or direction of information flow detailed by various authors (Arnstein, 1969; Farrington, 1998; Wilcox, 2003; Rowe & Frewer, 2000; Lawrence, 2006). Participation is a key aspect of learning which is seen as a social process in which participants in on-going interaction and negotiation determine what is socially known and working out mutually acceptable solutions to a problem that affects them (Koutsouris, 2008). Stakeholder participation is thus of interest in this study as a prerequisite in the RDM process, with the potential of a considerable social learning dimension.

Boakye and Akpor (2012) argue that attention should be shifted to how best to make participation more meaningful to the public. Boakye and Akpor (2012) assert that emphasis needs to be placed on the development of skills and capacity of participants, especially those from the disadvantaged communities, to understand and make meaningful contributions (ibid.).

The achievement of water security requires sustainable and integrated water resource management involving a wide range of stakeholders (South Africa. DWA, 2013; Gauteng City Regional Observatory [GCRO], 2019) navigating the dynamics of water management together (Angelstam et al., 2013). Achievement of IWRM requires co-ordinated development and management of water, land and related resources, to maximize economic and social welfare in an equitable manner and without compromising the sustainability of vital ecosystems

(GWP, 2000). The need for co-ordinated efforts across the range of role-players is due to the interconnections between users, water resources and the environment (GCRO, 2019).

The RDM process must be undertaken in consultation with stakeholders. The National Water Resource Strategy (South Africa. DWAF, 2004, p. 57) specifies that:

The classification system for water resources is to be established (prescribed) in terms of Section 12 of the Act by means of regulations after mandatory public consultation and consideration by Parliament. The determination of the Class, the Reserve and Resource Quality Objectives for a water resource are to be established by Government Notices in terms of Sections 13 and 16 of the Act respectively, following mandatory public consultation. (South Africa. DWAF, 2004, p. 57)

The stakeholder engagement requirements were further specified in DWAF (2007, p. 8) indicating that:

stakeholders should be consulted both in the development of the WRCS [Water Resource Classification System] and in the process of classifying the Nation's water resources. The approach should be legitimate and transparent, and ensure that the evaluation method used for determining trade-offs is fair. As the Management Class [former name for Water Resource Classes] has considerable economic, social and ecological implications, stakeholders will need to be informed in a meaningful way of the potential impacts on and risks (and benefits) of the WRCS to them.

2.2.5 Capacity

Morgan (1998, p. 2) defined capacity as “the organisational and technical abilities, relationships and values that enable countries, organisations, groups, and individuals at any level of society to carry out functions and achieve their development objectives over time”. The UNDP (1998, p. 5) defined capacity as “the ability of individuals and organisations or organisational units to perform functions effectively, efficiently and sustainably”, the power of something (a system, an organisation, a person) to perform or produce (*ibid.*, p. 6). Both

definitions highlight capacity as the ability of individuals or organisational units to execute functions effectively to meet their objectives; and frame it as not a fixed and passive state but a continuous process, and broader than technical skills (see Section 1.2.3), encompassing not only skills and knowledge but also relationships, values and attitudes, among others (Morgan, 1998; Matachi, 2006).

Capacity development is often used interchangeably with capacity building (Matachi, 2006). In the international aid context, the Japanese International Cooperation Agency (JICA, 2004, p. 7) explained that capacity development is not the same as capacity building. Part of the reasoning behind the word "development" taking the place of "building" is to stress the "endogenous development process of partner countries". The term "building" connotes "creating something that does not exist". This term might increase the tendency to underestimate the agency and potential of the development partner. It is vital to recognise that the role of capacity building facilitators is to build on the possibilities that already exist in a country or organisation without undermining their initiative. "Our role is also to create an enabling environment to contribute to the sustainable development of the partner country" (JICA 2004: p. 7).

The United Nations Educational, Scientific and Cultural Organization (UNESCO)'s International Institute for Capacity Building in Africa (IICBA) (2019) also explained that the terminology of capacity building has evolved into a more widely accepted term of capacity development, due to the building metaphor's implication that one is starting from little or nothing, assuming that there is no existing capacity from which to start. Development implies a more organic process that instead acknowledges and builds on the capacities and knowledge which already exist in the participants and targets.

In addition, UNESCO IICBA (2019) cautioned that at a superficial level, capacity building has been equated to training. However, it is well known that "training may benefit individuals without strengthening the capacities of institutions and countries to perform their responsibilities more effectively" (Matachi, 2006, p. 2).

Matachi (2006) elaborated that individuals who have benefited from high level training may not be able to put their newly acquired skills to good use where their home institutions are not receptive to application of such skills. Lack of understanding and appreciation of these newly acquired skills may lead to a mismatch of trained personnel and tasks, with personnel being assigned to tasks for which they have not been trained and in which they have no experience. Unless capacity building is targeted at *both* individuals and institutions, its benefits might not be realised. Capacity building must therefore be defined as building up institutional capacities first and foremost (ibid.).

The overall context within which organisations undertake functions are also key considerations in capacity development. Matachi (2006) emphasised the need to take account of the three levels of capacity categorised in a system by the UNDP (1998, p. 7) as “individual”, “organisation” and “environment”, depicted in Figure 2.1.

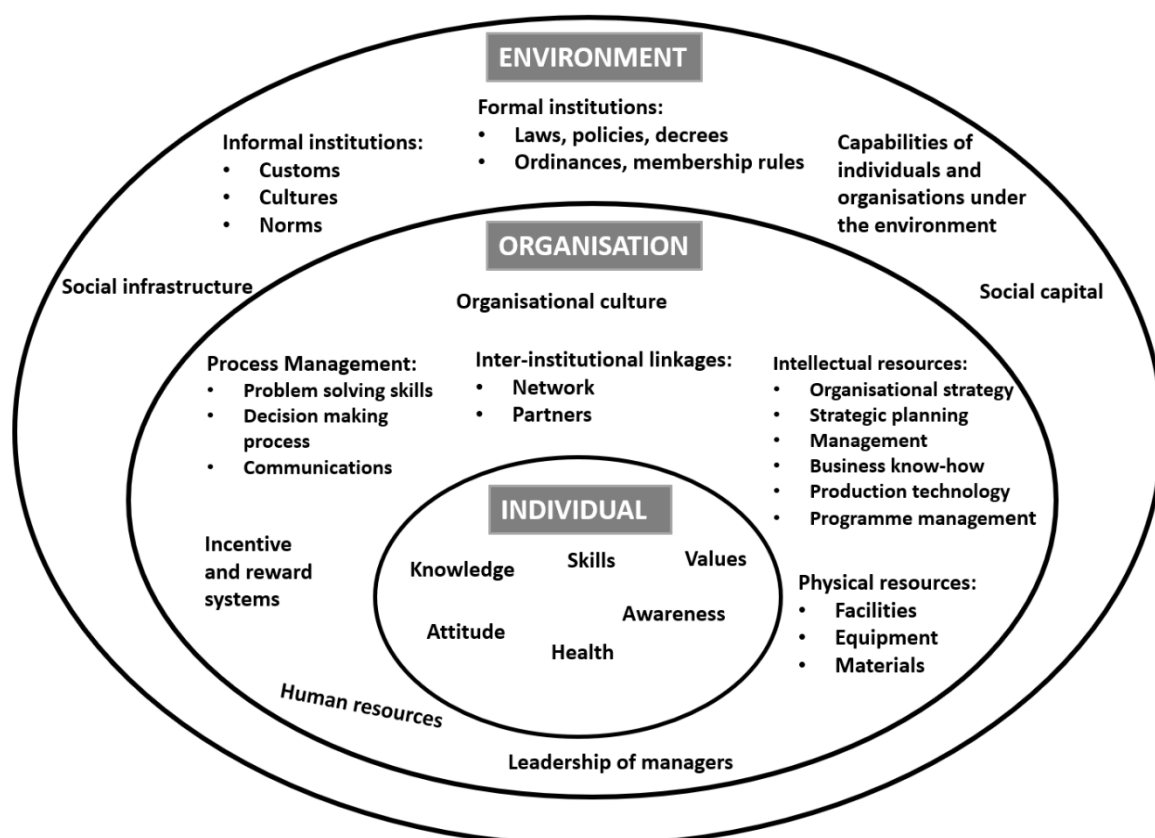


Figure 2.1: Levels of capacity

Source: Adapted from UNDP (1998) and Matachi (2006)

Matachi (2006) provided a summary of what each level entails. Firstly, capacity at the individual level is the most fundamental element that becomes the foundation for organisational capacity and refers to the will and ability of an individual to set objectives and to achieve them using one's own knowledge and skills. Capacity at the individual level includes knowledge, skills, value, attitude, health, awareness, among others. It can be developed through formal or informal education, training, on-the-job-training, independent reading, among other ways.

Secondly, capacity at the organisation level determines how individual capacities are utilised and strengthened. It refers to anything that will influence an organisation's performance, including human resources (capacities of individuals in the organisation), physical resources (facilities, equipment, materials), intellectual resources (organisation strategy, strategic planning, management, business know-how, production technology, program management), process management (problem solving skills, decision-making process, communications), inter-institutional linkage (network, partnership), incentive and reward systems, organisational culture and leadership of managers (Matachi, 2006).

Capacity at the environment level refers to the environment and conditions necessary for demonstrating capacity at the individual and organisational levels. This includes systems and frameworks necessary for the implementation of policies and strategies beyond an individual organisation. There are various dimensions on environment such as administrative, legal, technological, political, economic, social and cultural aspects that impinge on and or mediate the effectiveness and sustainability of capacity building efforts. Elements on which capacity is based on at the environment level include formal institutions (laws, policies, decrees, ordinances, membership rules), informal institutions (customs, cultures, norms), social capital and social infrastructure, and capacities of individuals and organisations under the environment (Matachi, 2006).

Among the prevalent South African water sector challenges are capacity issues as detailed in Section 1.2.3. Capacity poses an important factor in the study given its importance for implementation of functions.

2.3 SOUTH AFRICAN WATER LEGISLATIVE AND INSTITUTIONAL FRAMEWORKS

In South Africa, a variety of policies, strategies and guidelines govern water ecosystems management and overall water resource management, outlined in Section 2.3.1.3. The water history in the country is intertwined to the political history and it is detailed in this section given the impact this had on shaping the water context.

2.3.1 Legislative framework

2.3.1.1 Water history pre-1994 in South Africa

The history of South Africa's water story traces back to the country's pre-democracy colonial era, as illustrated in Figure 2.2. The arrival of the Dutch led by Jan van Riebeeck and the Dutch East India Company in 1652 at what they termed the Cape of Good Hope formed the Cape Dutch Colony under control of The Netherlands; and introduced Roman-Dutch Law with a formal system of private land ownership. This compromised the livelihoods of the Khoisan and other indigenous groups, who depended on land and natural resources (Funke et al., 2007; Uys, 1996). In 1805, the British Government took over the Cape Colony and began an extended process of water, land and institutional reform, including the formalisation (incorporated into law) of the riparian system. A growing focus placed on irrigation for agriculture culminated in the promulgation of the 1912 Irrigation Act (Funke et al., 2007).

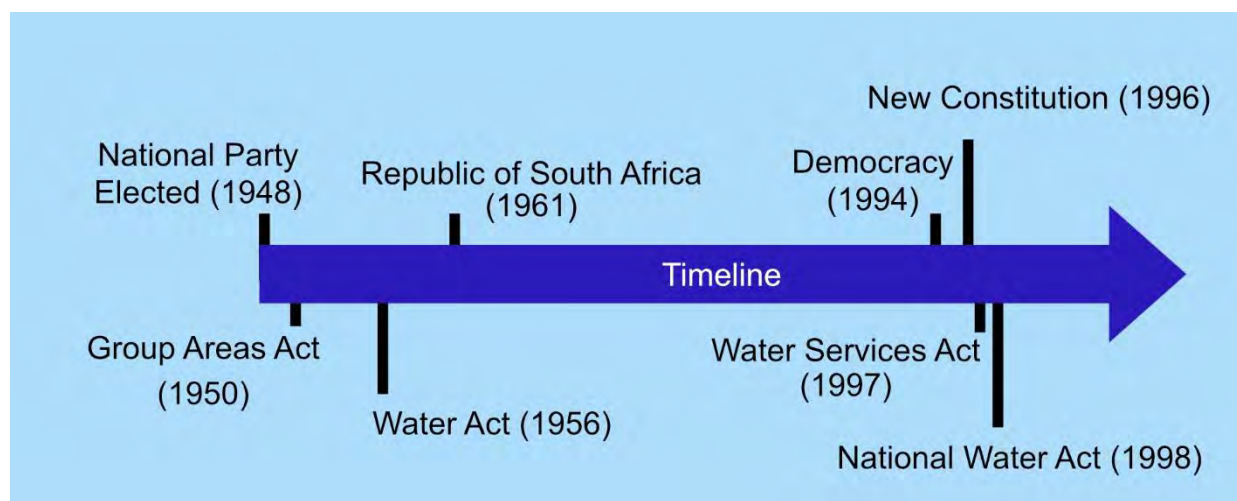


Figure 2.2: South African water policy history

Source: Adapted from Funke et al. (2007)

In 1886, gold was discovered in the Witwatersrand which led to the settlement of a large number of people in the City of Johannesburg. The Rand Water Board was established in 1903 to satisfy the demand for water and sanitation services in the area and the mines (Swatuk, 2010; Funke et al., 2007). A vast number of South Africans were, however, neglected in terms of access to water in the creation of 'non-white' areas through the 1950 Group Areas Act. In 1948, the National Party came into power with the apartheid political dispensation. Shortly after, the 1956 Water Act (Act 54 of 1956) was promulgated tying people's right to use water to land ownership. This law created highly inequitable, racially divided access to water through riparian rights as black South Africans could not own land under the apartheid regime. The 1956 Water Act gave rise to the Department of Water Affairs (DWA), mandated with the task of providing and allocating water for development in the agricultural sector, where a large part of the ruling National Party's support base was located. Water infrastructure expanded in number and size, for years, to pursue unequal economic development in the country (Funke et al., 2007).

Under apartheid, black people in South Africa, who were officially denied the right to citizenship, had very few basic rights, legalised by the promulgation of several discriminatory policies. This also affected their access to potable water and sanitation as the DWA controlled the apportionment and development of South Africa's water. Black 'homelands' were created through the separatist policies of apartheid, including Bophuthatswana, Ciskei, Lebowa, Venda, Gazankulu, Qwaqwa and KwaZulu homelands (Dugard, 1980). These were meant to be independent and self-governing, and had to negotiate to obtain water rights and use permits, in competition with users outside of these territories (Tewari, 2009). Water thus became a very effective tool in the apartheid government's strategy of oppression and control.

This system provided water for the exclusive benefit of the chosen few white South Africans, using high level technical engineering and financial capacity and political support, which according to Funke et al. (2007), aided the increase in large-scale government funded inter-basin transfer water schemes in the 1960s, 1970s and 1980s (Swatuk, 2010). According to Funke et al. (2007), this exclusion intensified when the National Party was given a decisive

boost in announcing its independence from Britain and the Republic of South Africa (RSA) was created in 1961.

Funke et al. (2007) report that, during the 1980s, a period of considerable political and social turmoil in South Africa, it became increasingly evident that the way water had been managed was unsustainable and had resulted in worrying levels of degradation of many of the country's primary water resources; exacerbated by droughts in the late 1980s and early 1990s. This forced the implementation of emergency water schemes. These developments had the purpose of ensuring the continued operation of coal- and water-based power stations and industry, as well as the provision of water for urban uses; this signalled a move away from the strong focus on irrigation for agriculture (Funke et al., 2007). In addition, the global trend toward the recognition and incorporation of environmental concerns into water resource management added to the pressure for change in water resource management (ibid.). The exploitation of water resources for industrialising and urbanising apartheid South Africa and the forceful relocation of people to arid rural areas came at a great social and environmental cost of land degradation (Swatuk, 2010); for example, harvesting wood as a fuel source led to deforestation, soil erosion and increased susceptibility to flash floods (Davies & Day, 1998).

Apartheid ended in 1994 with the first democratic elections, ushering in a period of radical political and societal change in South Africa. The adoption of a democratic dispensation was based on a new Constitution and the country embarked on policy reform (see Section 2.3.1.2).

2.3.1.2 Legislative context post-1994 in South Africa

The overarching legislation applicable to all laws is the Constitution of the Republic of South Africa (hereafter the Constitution; South Africa, 1996). Chapter 2 of the Constitution (South Africa, 1996) states that:

everyone has the right (a) to an environment that is not harmful to their health and well-being; and (b) to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that - (i) prevent pollution and ecological degradation; (ii) promote conservation; and (iii)

secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. (South Africa, 1996, p. 9)

In addition, the Constitution states that “everyone has the right to have access to sufficient food and water” (South Africa, 1996, p. 11).

The NEMA (South Africa, 1998b), also plays an overarching role through its Specific Environmental Management Acts (SEMAs) which provide principles and procedures which inform other environmental policies, strategies, regulations, including the National Water Act, 1998 (Act 36 of 1998). Examples of SEMAs relevant to water resource protection include National Environmental Management: Biodiversity Act 10 of 2004 (South Africa, 2004) and National Environmental Management: Waste Act 59 of 2008 (South Africa, 2008).

The White Paper on a National Water Policy for South Africa followed in 1997 (South Africa. DWAF, 1997) and captured the goal for water resource management in South Africa in the succinct slogan ‘some, for all, forever’ (South Africa. DWAF, 1997). The White Paper explains that:

- (a) ‘some’ refers to access to a limited resource, hence the recognition that water is a finite resource, though regenerating;
- (b) ‘for all’ is a fundamental commitment to equitable utilisation; and
- (c) ‘forever’ refers to water sustainability, now and in the future.

This ambitious strategy towards ‘some, for all, forever’ (South Africa. DWAF, 1997) sets the scene for a challenging and uncertain situation in which organisational learning must feature strongly.

DWAF (South Africa. DWAF, 1997) elaborated the provisions of the White Paper and indicated the need to limit our demand on water resources, ensure careful and efficient utilisation of water resources, accepting that water resources will be utilised for all water uses, to benefit all the people of South Africa. The authors conclude that it is a commitment to sustainable management, the willingness to balance the needs for long term access to the resource

against the needs for short term development and utilisation. This commitment comes with the responsibility to protect the ability of water resources to sustain long term utilisation, which requires protection of the structure, integrity and functioning of aquatic ecosystems (ibid.).

In the same year, 1997, the rights of access to basic water supply and basic sanitation were provided in the Water Services Act 108 of 1997 (South Africa, 1997) which recognises that although the activity for provision of water supply and sanitation is distinct from overall management of water resources, it must be undertaken in a manner consistent with the broader goals of water resource management (South Africa, 1997).

The White Paper (South Africa. DWAF, 1997) led to the NWA (South Africa, 1998). The NWA (South Africa, 1998) eradicated riparian (private) water resource ownership, transitioned to licensing water uses and provided for acceptable domestic water uses that do not require licensing, commonly known as water rights. The NWA (South Africa, 1998) recognises water scarcity and unevenly distributed water resources in the country and presents the aim of water resource management as achieving the sustainable and equitable access to water for all users. It further states that water should be “protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons ... while promoting environmental values” (South Africa, 1998, p. 18).

The principles of decentralisation are enshrined and implicit in the NWA (South Africa, 1998, p. 3), which calls for “the delegation of management functions to a regional or catchment level so as to enable everyone to participate”. According to Pollard, Riddell, du Toit, Retief and Ison (2023), these NWA (South Africa, 1998) principles embrace an integrated, catchment-based approach framed by IWRM (see Section 2.2.1), committing to meeting basic water needs of all while ensuring long-term sustainability. Decentralisation is the process through which powers, functions, responsibilities and resources are transferred from central to local government or other localised entities and is meant to enhance local water resource management (United Nations, 2009). Local entities considered in this study include government provincial offices, CMAs and municipalities (local and district). An important

turning point for South Africa given the pre-1994 history of exclusion of majority of the citizens as detailed in Section 2.3.1.1.

2.3.1.3 Policies, strategies, guidelines and plans

Various strategies and guidelines across sector institutions inform water resource management in South Africa. The National Development Plan (NDP) sets the broad vision for South Africa's development and identifies key milestones and targets to be achieved in various sectors to eliminate poverty and reduce inequality by the year 2030 (South Africa. NPC, 2012).

Every five years, DWS develops the National Water Resources Strategy (NWRS) which is the legislative strategy required for implementing the NWA (South Africa, 1998); at the time of thesis writing, the latest, NWRS 3 was published in 2023. The NWRS provides a framework for IWRM to guide water resources management at the local or catchment level for South Africa. The review provision every five years was viewed in Pollard (2011) as a recognition of a new and uncertain path. According to DWAF (2004), DWS needs the opportunity to re-evaluate developments in the social and economic environments and to adapt water resources management approaches to suit changing circumstances and needs. In concurrence, Ison et al. (2007) and Pollard et al. (2007) were of the view that this recognizes the need for learning and that there is a co-evolution of social-ecological systems, for which traditional, reductionist, and linear management approaches were inappropriate.

The National Water and Sanitation Master Plan (NW&SMP), on the other hand, is the action plan that details implementation of the NWRS and specifies priority actions for the water sector (South Africa. DWS, 2018). Together, the NWRS and NW&SMP are the primary tools for managing water resources across all sectors to achieve national government's development objectives (South Africa. NPC, 2012).

A CMA, defined in Section 1(1)(xxvi) of the NWA (South Africa, 1998) as a water management institution responsible for water resources management, has a responsibility to develop a

Catchment Management Strategy in consultation with stakeholders, outlining all the key actions at catchment level.

The National Freshwater Ecosystem Priority Areas (NFEPA) maps and supporting information play a key role for IWRM and form part of a comprehensive approach to sustainable and equitable development of South Africa's scarce water resources. The NFEPA guide how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA (South Africa, 1998) and for biodiversity resilience and persistence (Nel et al., 2011).

Examples of other relevant policies, strategies, guidelines and plans include the National Biodiversity Strategy and Action Plan (South Africa. Department of Forestry, Fisheries and Environment [DFFE], 2016), the Integrated Water Quality Management (IWQM) Policies and Strategies for South Africa (South Africa. DWS, 2017), the Eutrophication Management Strategy for South Africa (South Africa. DWS, 2023), and the National Waste Management Strategy (South Africa. DFFE, 2020). The determination and implementation of RDM, particularly the Water Resources Classes (also referred to as Classes), Reserve, and Resource Quality Objectives (RQOs) are the focus of the current study, detailed next.

2.3.1.4 Resource Directed Measures (RDM) for water resource protection

Legislatively, in terms of ecological considerations, Chapter 3 of the NWA 36 of 1998 (South Africa, 1998) is devoted to the comprehensive protection of water resources and provides a series of RDM intended to achieve this protection. These include the Classification of Water Resources (Part 1, Section 12-15), the determination of the RQOs (Part 2, Section 13-15), and the Reserve (Part 3, Section 16). Therefore, Classes, the Reserve and RQOs together constitute RDM.

The NWA 36 of 1998 (South Africa, 1998, p. 26) Section 12 (1) stipulates that a system for classifying water resources should be established; with procedures for determining the Reserve and procedures required to satisfy the water quality requirements of water users as far as possible. Such a system is required to be used to determine the Classes, Reserve, along

with RQOs, “of all or part of water resources considered to be significant”. Furthermore, “once the class of a water resource and the resource quality objectives have been determined they are binding on all authorities and institutions when exercising any power or performing any duty under this Act” (South Africa, 1998, p. 28).

To this end, Regulations Number 810 (hereafter Regulations 810) for the establishment of the Classification System (South Africa. Department of Water Affairs [DWA], 2010) were formulated and published in the Government Gazette GG 33541 of 17 September 2010. They provide step-by-step guidance on the process for RDM determination, as outlined in Table 1.2. The NWA speaks of “preliminary” RDM determinations (South Africa. DWAF, 2004, p. 60). An example is the Preliminary Reserve, preliminary in this context refers to a determination carried out before the formal prescription of the classification system. This is a transitional measure that makes it possible to license water use while the classification system is being developed and established in terms of the NWA (ibid.).

The National Water Resource Strategy 1 (NWRS 1) elaborated that RDM are a requirement of the NWA 36 of 1998 (South Africa, 1998) for water resource protection (South Africa. DWAF, 2004). According to the National State of Water report (South Africa. DWS, 2021), RDM represents the first stage in the protection of water resources. These measures focus on the quality of the water resource in terms of its overall health and ecological status. Resource quality includes water quantity and water quality, the character and condition of in-stream and riparian habitats, and the characteristics, condition and distribution of the aquatic biota as variables (South Africa. DWAF, 2004, p. 60). To this effect, NWA (South Africa, 1998) requires RDM Water Resource Classes to represent three conditions of water resource use as outlined in Table 2.2.

Table 2.2: Description of Water Resource Classes

Source: South Africa. DWS (2022)

Classes	Description of Use	Ecological Category	Description of Water Resource
Class I	Minimally used	A – B	Minimally altered
Class II	Moderately used	C	Moderately altered
Class III	Heavily used	D	Heavily altered

The Water Resource Classification system (WRCS) allows for determination of different levels (see Table 2.2) of protection for water resources. The ecological category is an indication of the assigned ecological condition of a water resource in terms of the deviation of its biophysical components from a reference (pre-development) condition. The reference condition describes the condition of the site or river reach prior to anthropogenic change and is formulated for each component (fish, aquatic invertebrates, riparian vegetation, water quality, geomorphology and hydrology) considered in ecological status determination (South Africa. WRC, 2008). Through RDM, the DWS recognises that some water resources, by virtue of their ecological importance, may require a higher level of protection, whereas others may serve the country's developmental and economic growth needs. Table 2.3 provides the Regulations 810 step-by-step guidance on the process for RDM determination.

Interlinkages between RDM steps were found and some linkages in steps were initially formulated by DWAF (South Africa. DWAF, 2002 & 2007). Later, Table 2.3 steps were revised as depicted in Appendix 1 to formulate an integrated process for Classes, Reserve and RQOs (South Africa. DWS, 2017b). The original version of these steps is provided here to demonstrate changes over time in the study context.

Table 2.3: Regulation 810 steps for RDM determination

Source: South Africa. DWA (2010)

Water Resource Classification	Reserve Determination	Resource Quality Objectives (RQOs)
Step 1: Delineate the units of analysis and describe the status quo of the water resources.	Step 1: Initiate the basic human needs and ecological water requirement assessment.	Step 1: Identify water users within each water resource management unit, and where appropriate, align with Step 1 of the water resource classification procedure.
Step 2: Link the socio-economic and ecological value and condition of the water resources.	Step 2: Determine eco-regions, delineate resource units, select sites and, where appropriate, align with step 1 of the water resource classification procedure.	Step 2: Determine the present state per water user and, where appropriate, align with Step 5 of the water resource classification procedure.
Step 3: Quantify the ecological water requirements and changes in non-water quality ecosystem goods, services, and attributes.	Step 3: Determine the reference conditions, presents ecological status and the ecological importance and sensitivity of each of the selected sites.	Step 3: Determine the desired water quality per user and, where appropriate, align with Step 6 of the water resource classification procedure.
Step 4: Determine an ecologically sustainable base configuration scenario.	Step 4: Determine the basic human needs and ecological water requirement for each of the selected sites and, where appropriate align with step 3 of the water resource classification procedure.	Step 4: Determine water user specifications and, where appropriate, align with Step 6 of the water resource classification procedure.
Step 5: Evaluate scenarios within the integrated water resource management process.	Step 5: Determine the operational scenarios and their socio-economic and ecological consequences.	Step 5: Determine water quality requirements of water uses and, where appropriate, align with Step 6 of the water resource classification procedure.
Step 6: Evaluate the scenarios with stakeholders.	Step 6: Evaluate scenarios with stakeholders and align with step 6 of the water resource classification procedure.	Step 6: Gazette and implement the resource quality objectives.
Step 7: Gazette and implement the class configuration.	Step 7: Design an appropriate monitoring programme.	
	Step 8: Gazette and implement the Reserve	

The Reserve is defined as the quantity and quality of water required to maintain a healthy aquatic ecosystem, whilst meeting basic human requirements. Whereas the RQOs, based on the Water Resource Class determined, specify appropriate numeric and narrative objectives

for different water resources, and can include indicators of water quality, as well as the biological and physical characteristics of the resource (DWAF, 2007). These RQOs as indicators provide direction for monitoring and maintaining ecosystem health.

Once the technical processes for the determination of Classes and the associated RQOs in a particular river system are completed, a legal notice for the proposed Classes and associated RQOs is published in the Government Gazette for a 60-day public commenting period. The public comments received are considered to finalise the Classes and the associated RQOs. Once the Minister of Water and Sanitation approves the final Classes and RQOs for the respective river systems, they are then published again in the Government Gazette and become legally binding on all institutions and authorities (South Africa. DWS, 2021).

In response to the prescriptions of Chapter 3 of the NWA (South Africa, 1998), the DWS's Water Ecosystem Management Chief Directorate, formerly RDM, has undertaken various initiatives to give effect to water resources protection mandate through projects for Water Resource Classification, determination of Reserves and RQOs (see Appendix 2). This study aims to establish possible learnings over the past ten years, from 2013 to 2023 in the implementation of the NWA's Chapter 3, through RDM projects as a case study of water ecosystems management for water resource protection in South Africa. Section 3.3.1 provides details on the RDM initiatives chosen for the current study.

It should be noted that other units within DWS also undertake water resource protection work, the function is broad. For example, the DWS Directorate Water Resources Regulation, formerly Water Resource Protection, in the Chief Directorate Water Use Compliance, Monitoring and Enforcement, also undertakes water resource protection activities, through development of standards and processes for water resource regulation. Among their functions is water use compliance monitoring, recently expanded to include RDM compliance monitoring, in response to a new DWS Annual Performance Plan (South Africa. DWS, 2021b) target. This expansion also responds to Sections 18 of the NWA, which requires ensuring that the RDM are implemented and monitored for compliance with RQOs.

2.3.2 Institutional framework

In South Africa, water resource management cuts across national and provincial levels of the DWS, as well as various other institutions (see Appendix 3 and Figure 2.3), and it involves multiple stakeholders, interested, affected or mandated on various functions. The DWS, is the national department mandated with the custodianship of water resources in South Africa, in terms of the NWA (South Africa, 1998). The functions of the DWS to manage water resources and services of South Africa for meeting the needs of current and future generations are extensive, across numerous branches responsible for different aspects of water management such as Water Resource Management; Regulation, Compliance and Enforcement; Provincial and Entity Governance and International Cooperation; Infrastructure Management; Water and Sanitation Services Management; and Corporate Support Services. The Water Resource Management branch includes Chief Directorates Water Resource Policy, Strategy and Evaluation; National Water Resources Planning; National Water Resource Information Management; and Water Ecosystems Management (South Africa. DWS, 2022b).

As a state organisation, the operations of DWS are governed through the public sector legislative mandates, institutional operational plans and strategies, with the ultimate goal of service delivery to citizens of South Africa as the main stakeholders. The DWS units, must all adhere to the government requirements and operational structures to achieve their respective objectives. The operations of the DWS can be seen to conform to a top-down operational approach in assigning roles and responsibilities, and ultimately reflects a hierarchical system of co-decision making, guided by the organisational structure. At national level, water resource management practitioners are mandated with the development of policies, guidelines and strategies (including determination of RDM); which are ultimately implemented at the catchment level. The practice of water resource protection (through RDM determination and implementation) in DWS is embedded within the broader Water Resource Management practice.

Role-players in IWRM in South Africa include national government, CMAs, regional water boards, local authorities, specifically local government, traditional leadership and provincial government, water user associations, civil society and private sector organisations (South

Africa. DWA, 2004; DWS, 2023). Other Key environmental regulatory authorities include the Department of Agriculture, Land Reform and Rural Development (DALRRD); Department of Forestry, Fisheries and the Environment (DFFE); and Department of Mineral Resources and Energy (DMRE). This cross-sectoral nature of water resource protection means that many policies are involved, each with their own multiple objectives, mandated to various organisations which creates complexity for management of water resources. In addition, the mandates of various institutions involved in IWRM at times overlap, further demonstrating complexity. An example is the mandate for water ecosystem management and the protection of rivers, wetlands and estuaries is a joint responsibility of the DWS and DFFE, and affiliated entities at national and regional levels, according to the NEMA (South Africa, 1998b). Figure 2.3 depicts the structural formation of the DWS, alongside key partner organisations and role-players, at each level, in relation to RDM.

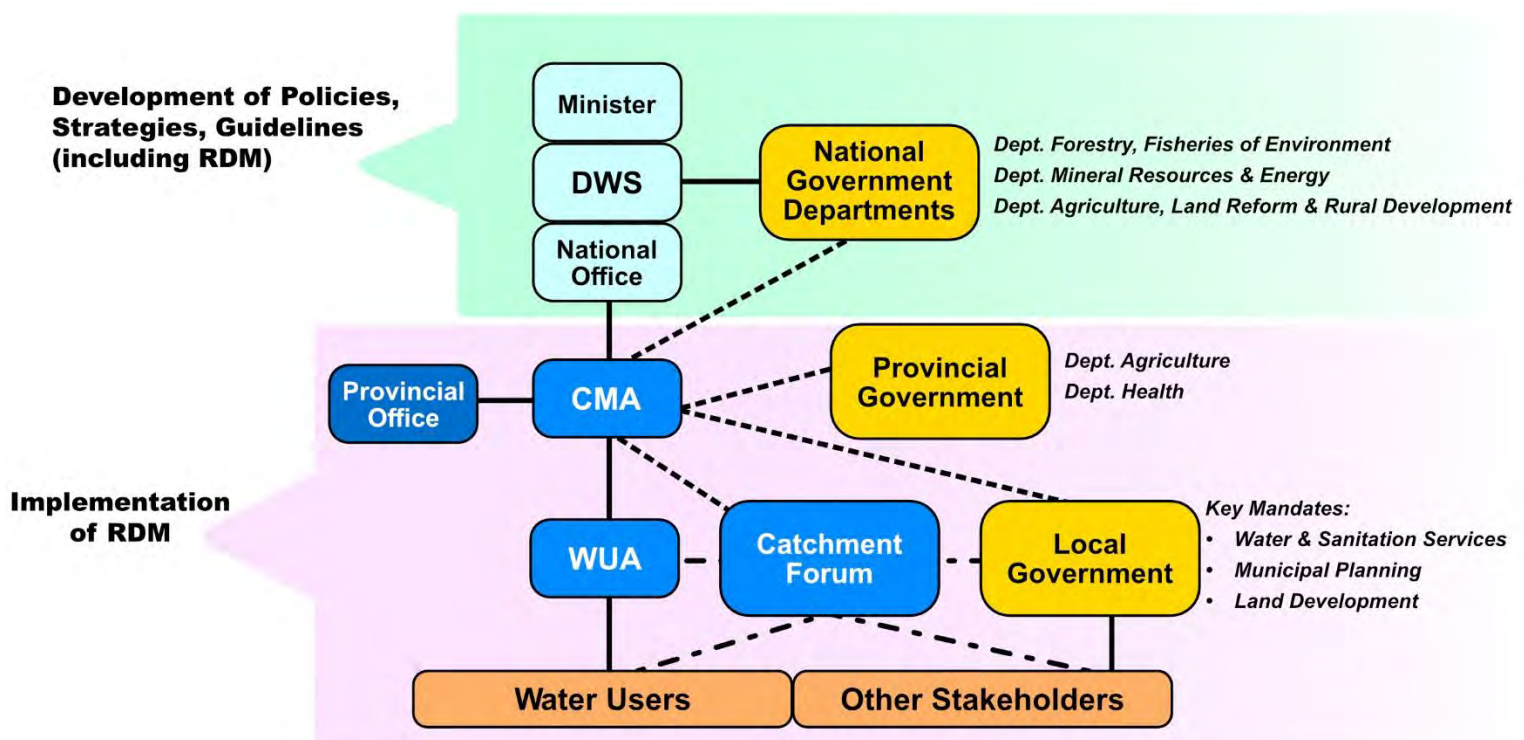


Figure 2.3: IWRM institutional role-players in South Africa

Source: Adapted from South Africa. DWAF (2006)

Appendix 4 outlines the role and responsibilities of the various interrelated water resource management institutions. At the catchment level, CMAs have been assigned as the implementation institutions. DWAF (South Africa. DWAF, 2004) described a CMA as a statutory body, established by Government Notice, with jurisdiction for water resources management in defined WMAs (see Table 1.1). Their role is to manage water resources and co-ordinate water-related activities of water users and other water management institutions within their areas of jurisdiction per WMA through the framework of a Catchment Management Strategy (*ibid.*). According to the NWA 36 of 1998 (South Africa, 1998), a CMA's role is to conduct the protection, use, development, conservation, management and control of water resources. A CMA is provided considerable flexibility in its approach to carrying out its duties (South Africa. DWAF, 2004).

2.4 LEARNING THEORETICAL FRAMEWORK

In the quest for sustainable development, learning does not take place in isolation; it occurs in “rich social contexts with innumerable vantage points, interests, values, power positions, beliefs, existential needs and inequalities” (Wals, 2007, p. 37). Learning has different meanings depending on whether it refers to processes involving individuals, collective agents or wider social systems (Tabara & Pahl-Wostl, 2007). As the contextual overview in Chapter 1 suggested, RDM for water resource protection in South African water ecosystems management is multi-institutional and presents a ‘rich social’ context for learning to take place. This study posits that such a context requires a particular kind of learning, calling for a social learning approach for exploring organisational learning, detailed in Section 2.4.1 and 2.4.2 respectively.

Section 2.4.3 provides a review of selected literature and discussion of activity theory, particularly CHAT as the epistemological theory, and critical realism (Bhaskar, 2008; see Section 2.4.5) as the ontological theory used to develop an in-depth understanding of learning in relation to water resource management in South Africa. CHAT (Engeström & Sannino, 2010; underlaboured by critical realism, helped me to dig deeper to surface underlying mechanisms in this study case that respond to the research objectives outlined in Section 1.4. The second generation of CHAT (Engeström & Sannino, 2010) introduced contradictions as potential

growth buds for learning and change in the study. Manifestations of these contradictions act as the windows to accessing them. Critical realism, stratified or layered (Bhaskar, 2008), is then used to explore the contradictions further and to unearth the causal mechanisms.

2.4.1 Social learning

Definitions of social learning vary across different fields. In organisational learning fields, Lave and Wenger (1991) and Wenger (1998) defined social learning as learning through active social participation in the practices of networks which they named communities of practice. This is aligned with the definition of social learning by Reed et al. (2010) in the field of sustainability science, described as a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice, through social interactions between actors within social networks. In the field of sustainability education, Wals (2007, p. 39) conceptualised social learning as “learning that takes place when divergent interests, norms, values, and constructions of reality meet in an environment that is conducive for meaningful interaction”. Rist, Chidambaranathan, Escobar, Wiesmann and Zimmermann (2007) and Gibbons et al. (1994), also in the field of sustainability science, defined social learning as a process of joint production of knowledge and definition of the norms, rules and power relationships that govern the use of natural resources aiming for negotiated transformations of these principles for sustainable development. In the field of climate change adaptation studies, social learning is defined as the process of co-creation of knowledge, which provides insight into the causes of a situation and the means required to transform it (Collins & Ison, 2009). Consequently, Glasser (2007) observed that with time the concept of social learning has intertwined with related ideas such as soft systems thinking and adaptive management. However, a consistent characteristic of the various approaches to social learning is that they advocate for multiparty collaboration processes with an interactive or participatory style of problem solving, whereby outside intervention takes the form of facilitation (Glasser, 2007; Pahl-Wostl et al., 2007).

Keen, Brown and Dyball (2005), in describing social learning for sustainable environmental management, proposed five intertwined strands of social learning, namely reflection, system orientation, integration, negotiation and participation. These strands of social learning are of

interest in the sustainable management of complex water resources described by Pahl-Wostl et al. (2007) as needing management practices that incorporate different sources of knowledge and a continuous process of learning from experience and new insights. Both leadership and facilitation have been found to play a key role (Tippet, 2005; Mostert, Craps & Pahl-Wostl, 2007). Pahl-Wostl et al. (2007) argued that this leadership does not refer to imposing a view on a group but rather collaborative leadership which can mobilize energies, generate trust, give vision, and support the collective finding of a clear direction in a multiparty process. Mostert, Craps and Pahl-Wostl (2007) explained that facilitation means interventions that are focussed on the social process among the stakeholders involved to support constructive interactions, including convening major stakeholders, structuring the process, selecting methods and approaches such as interactive modelling. Facilitation of a process that leads to individual and organisational capacity to act includes a process design that considers trust, transparency, respect, and openness (Muro & Jeffrey, 2008). Aligned to this, in the field of environmental education, Lindley (2014) identified the most important elements of social learning for supporting transformative change as: changing values, beliefs, ideologies and assumptions; dissonance as a precondition for learning; facilitating important thought processes for social learning; reflexivity; clarifying the meaning of participation; and of valuing social learning processes over products.

Glasser (2007, p. 49) differentiated between two types of social learning including passive social learning (such as reading a newspaper, non-interactive lecture attendance, internet download of a recipe) which is derived from the “prior learning of others” who are often positioned as experts. The second type of social learning was active social learning, built on conscious interaction and communication between at least two living beings. It is inherently dialogical and broken into three categories. (a) Hierarchical active social learning (based on predetermined, inflexible relationships such as those established between teachers and learners); (b) non-hierarchical active social learning (based on two-way learning, where each participant, as an “expert” in their own right, shares their knowledge and experience); and (c) co-learning, based on non-hierarchical relationships, collaboration, trust, full participation, and shared exploration (Glasser, 2007, p. 51). Co-learning requires team building, complete engagement, “learning-by-doing” and accountability. In addition to supporting the

penetration of existing knowledge, it supports the generation of new knowledge and novel strategies for addressing real-world problems. Co-learning supports change, positive change in particular, by building capacity in three fundamental areas: critical evaluation of existing knowledge and problems; knowledge generation and penetration; and application of this new knowledge in policy, practice, and everyday life. As examples, active social learning can take place in the context of a conversation, a community meeting, an open, participatory public review process, or video conferencing over the internet. Opportunities for cross-pollination and emergence make it much more effective than passive social learning, at creating innovations and widely diffusing novel behaviours (*ibid.*).

According to Glasser (2007), active social learning has the potential to promote more open and equitable learning processes because of the opportunity to directly engage both a broad range of perspectives and the whole human. Furthermore, the potential to receive direct feedback offers a powerful motivation for challenging the desirability of the underlying, taken-for-granted assumptions, values, and principles, such as the orthodox notions of progress that guide our theories-in-use, routinised policies, practices, and individual behaviours. As such, the highest, most diverse and participatory forms of active social learning appear to offer a viable prospect for combating maladaptation. This is supported by the thinking of Rosenberg, O'Donoghue and Olvitt (2008) who argued that an active learning framework that holds the three processes identified by O'Donoghue (1993), namely encounter, dialogue and reflection, offers a coherent learning experience.

It is believed that these highest forms of active social learning can be used with great advantage in learning environments and decision-making processes to promote a societal shift toward ecocultural sustainability (Glasser, 2007). According to Pahl-Wostl et al. (2007) and Cundill, Cumming, Biggs and Fabricius (2012), social learning occurs at approximately three interdependent levels of time scales and impact, including:

- short to medium – at the level of processes between collaborating stakeholders, and the level of the individual undergoing cognitive, attitude and behavioural changes;
- medium to long – at the level of change in practices by the community or actor networks (with possible outcome or feedback of processes); and

- long – at the level of change in the wider system such as the governance structure (formal and informal institutions and cultural values, norms, and paradigms) (*ibid.*).

Multilevel change is assumed to proceed in an iterative non-sequential fashion through feedback between these levels. The ultimate goal is to improve the state of the environment (such as improved quality of water resources), which in practice, often implies a change in the governance structure. A change in governance may imply the implementation of new laws, the formation of water-user associations or voluntary cooperative agreements, which would result in organisational change as per governance explanations provided in Section 2.2.1. It may also lead to changes in norms and cultural values when change is linked to a larger societal perspective (Pahl-Wostl et al., 2007). Cundill et al. (2012) argued that it is at the latter two levels that transformation of natural resource management practices can be observed as a potential outcome of social learning. These authors found that social learning is an important feature of adaptive co-management of natural resources and that it can occur at these different levels in a system (*ibid.*). Hence, depending on the level where it occurs along the outlined spectrum, social learning can facilitate societal change.

Reflexivity and reflection are both important aspects of social learning (Wals, 2007). Reflexivity is described by Wals (2007 and 2007b) as a crucial element that encourages people to question and reflect on their views or understanding and, if necessary, break away from existing paradigms and ways of doing things. Reflexivity is learning which involves individuals or groups developing knowledge and values and participating in making choices, coming up with solutions by reviewing a number of options and being able to take collective action addressing complex and continually changing problems, instead of taking what is instructed by an expert who has predetermined solutions and has decided how things are and should be. Beck (1992, p. 21) described a shift in society at large becoming more “reflexive” and responding to growing environmental and social risks, where he defines risk as “a systematic way of dealing with hazards and insecurities induced and introduced by modernisation itself”. O’Donoghue and Rosenberg (2024, p. 33) called for educational activities to recontextualise abstract knowledge for “activating reflexive learning actions and deliberative co-engagement”.

Sol, Beers and Wals (2013) found that trust, commitment and reframing are emergent properties of social learning which are continuously produced through the actions of the individual actors. In addition, frame changes and changes in mutual trust and commitment influence the actions of the actors involved. Therefore, the social learning process can be seen as the continuous iteration of communicative actions by the project partners, including their contribution to new local knowledge and their questioning of each other's claims and values (*ibid.*). Through this iterative process, individuals gain new learnings that might lead them to some changes in their actions which may feedback into their organisation through their behavioral changes or sharing, and in this way influencing organizational learnings.

Social learning concepts that resonate with this study frame learning as a joint production of knowledge (Gibbons et al., 1994; Glasser, 2007; Rist, Chidambaranathan, Escobar, Wiesmann, & Zimmermann, 2007); takes place when divergent interests, norms, values, and constructions of reality meet in an environment that is conducive for meaningful interaction and reflexivity (Wals, 2007); active and deliberative learning (O'Donoghue & Rosenberg, 2024); and leading to change in understanding that goes beyond the individual to become situated within wider social units through social interactions between actors (Reed et al., 2010). This is because stakeholder engagement is a core element in RDM, where project processes are intended to be generated jointly, and in close consultation with interested and affected stakeholders. It is key to note that social learning, consisting of participatory, active and deliberative processes, involves co-learning, not only with external natural resource management stakeholders, but also among the organisations' natural resource management members themselves. According to Wals (2007, p. 466) such processes should include "reconstruction" and "revisiting assumptions and perceptions", which they call "un-learning" about nature, and in this case water ecosystems management specifically. "This involves, among other things, building relationships of trust with different users and user groups and looking for shared norms and rules" (*ibid.*). Sol, Beers and Wals (2013) found that facilitation can offer a place where people feel secure, are not afraid to make mistakes, and can mediate between the different frames and interests that actors and their constituencies have, thereby fostering the development of trust. According to Wals (2009), facilitation within a social learning process involves 'boundary crossing' capacity, this may entail moving across

boundaries to seek and give help on horizontal expertise, information and tools wherever they happen to be available.

2.4.2 Organisational learning

Early work by Argyris and Schön (1978) conceptualised organisational learning by adopting a broad sociocultural approach as the growth of a culture of open communication, within which members of an organisation collaborate in organisational enquiries to discover better ways of achieving the organisation's purpose. Argyris and Schön (1978) mapped levels of learning into single loop and double loop learning. Single loop learning corresponds to routine learning that takes context as given and occurs when error detection "permits the organization to carry on its present policies or to achieve its present objectives" (Argyris & Schön, 1978, p. 2). Single loop learning thus focuses on detecting and correcting errors without changing or questioning organisational rules, plans or guidelines, with a focus on refinements for improving performance (Mudau-Mushwana, 2020). On the contrary, double loop learning involves detection of errors and correcting them in ways that modify an organisation's underlying norms, policies and objectives (Argyris & Schön, 1978). Georges, Romme and Van Witteloostuijn (1999) expanded on the work of Argyris & Schön into triple loop, where learning explores the structural opportunities and key competences people need to participate in making well-informed choices about policies, objectives and other issues at hand.

Collins and Ison (2009) explain that although single loop and double loop learning levels are not specific to social learning theory, they provide a useful lens on social learning processes as they juxtapose routine learning from learning that questions starting assumptions and explores context. These authors make the link that social learning in a policy and praxis context can generate practices that question existing norms, policies and objectives in interactive processes involving multiple stakeholders (ibid.).

According to Gibbons et al. (1994), mutual learning occurs within an organisational team as insights, experiences, puzzles and solutions are shared. One solution is found applicable to a completely different problem, someone else's failure turns into a winning strategy for

accomplishing something entirely unrelated. It is as if team members were doing several jigsaw puzzles simultaneously with pieces from the same pile – pieces which could be arranged to form many different pictures (ibid.).

Later conceptualisations of organisational learning by Argyris and Schön (1996, p. 16) described it as:

learning that occurs when individuals within an organisation experience a problematic situation and inquire into it on the organisation's behalf. They experience a surprising mismatch between expected and actual results of action and respond to that mismatch through a process of thought and further action that leads them to modify their images of [the] organisation or their understandings of organisational phenomena and to restructure their activities so as to bring outcomes and expectations into line, thereby changing organisational theory-in-use. In order to become organisational, the learning that results from organisational inquiry must become embedded in the images of the organisation held in its members' minds and/or in the epistemological artifacts (the maps, memories, and programs) embedded in the organisational environment.

Argyris and Schön (1996, p. 17) indicated that for the learning products of organisational inquiry to qualify as learning, they must include "evidence of a change in organisational theory-in-use", and that often such changes are mediated by lessons drawn from inquiry. They further asserted that such intermediate outcomes of inquiry only qualify as products of organisational learning when they are accompanied by changes in behavior that signify changes in organisational theory-in-use.

Brown and Duguid (1991), Cook and Yanow (1993) and other researchers supported a socio-cultural perspective into organisational learning, building on the concepts of Lave and Wenger (1991) relating to situated learning and communities of practice, and the importance of learning across boundaries. Boreham and Morgan (2004, p. 308) defined the socio-cultural approach to organisational learning as "learning that is perceived as being embedded in social

and cultural contexts, and best understood as a form of participation in those contexts”. They found that this concept of learning implies the simultaneous transformation of social practices and the individuals who participate in them, and thus the social and individual dimensions of learning are mutually constitutive (ibid.). Wals (2007), in alignment, indicated that learning occurs in rich social contexts similar to South African water ecosystems management contexts of shared responsibility for water resource protection with socio-culturally, economically and politically diverse role-players.

The current study is interested in the learning that occurs within an organisational context, namely the DWS, beyond the individual, and the learning exploration that considers the social, historical, cultural contexts within which learning among groups is taking place, and how this learning penetrates the organisation. Here it is important to note that, as Wang and Ahmed (2003, p. 9) warned, although “a learning organisation is founded on the learning process of individuals in the organisation, individual learning does not necessarily lead to organisational learning”. As explained by Wenger-Trayner, Wenger-Trayner, Cameron, Eryigit-Madzwamuse and Hart (2017), people gain new insights and resources through participation in learning interactions which may lead them to change their practice expectantly with improved ways of executing their functions. Through the process, they may be transformed, and/or it may transform their environment. Learning is deemed to come full circle when they feedback these effects into their work groups and communities; and it is the loops between learning interactions, insights, results and feedback that constitute social learning (ibid.). A group is considered to be successful at social learning when it learns about and reframes shared issues and actively engages different groups in society in a process from understanding contradictions (see Section 2.4.3.3) such as *conflicts* and *dilemmas* towards implementing strategies together for dealing with them (Woodhill, 2003). The notion of contradictions as sources of learning is particularly pertinent in CHAT, which is another, complementary, framing for learning, discussed next.

2.4.3 Activity theory

Activity theory entails an extensive body of work in the social, educational and organisational sciences that originates from the work of the late educational psychologist Lev Vygotsky who founded the concept of mediated action (Vygotsky, 1978; Engeström, 2001). The concept was crystallized in Vygotsky's triangular model of 'a complex, mediated act' which is commonly expressed as the triad of *subject*, *object*, and *mediating artifact* (Engeström, 1987), described further in Section 2.4.3.1. This work provided an advance on behavioural psychology that posits learning and behaviour to be more or less mind-less reactions to stimuli. The concept of mediated action explains that humans make meaning and engage in mindful actions that are mediated in the cultural, historically shaped settings in which they live, learn and work, by language and other symbols (Edwards, 2005). Thus, a government official's actions (or inactions) may be mediated by policy guidelines passed on by the institutional mandate, as well as stakeholder consultations in which constituencies voice water-related concerns. An activity is defined as a process that is elicited and directed by a motive (Leont'ev, 1978). According to Engeström (2014) an activity is oriented toward an *object* (see Section 2.4.3.1), which carries and embodies the true motive of activity, its meaning and purpose in society. Activities are always mediated with human-made *artifacts* or *tools* or *instruments* (used interchangeably in this study) by which action is executed, such as various types of machines, computers, language, signs (ibid.). This first generation activity work of Vygotsky (1978), articulated the relationship between individuals and their socio-cultural environment (Yamagata-Lynch, 2010). The limitation of this first generation activity theory was that the unit of analysis was the individual. As outlined in Section 1.2, multiple role-players are involved in water resource protection in the South African water sector, and because the focus of the study is social and organisational learning, there is merit in using the second generation of activity theory.

2.4.3.1 Cultural Historical Activity Theory (CHAT)

The second generation of activity theory builds on the work of Leont'ev who explicated the difference between an individual action and a collective activity (Engeström, 2001). Leont'ev (1978, 1981) focused on those activities that eventually lead to the internalization of external human actions in the form of inner mental processes which can also be described as learning.

The unit of analysis here is the collective activity system (Engeström & Sannino, 2010). According to Leont'ev (1978), human activity has a hierarchical structure. Individuals' actions are always situated in the context of a historically developed collective praxis, an activity system. However, Leont'ev never graphically expanded Vygotsky's original model into a model of a collective activity system, this was done by Engeström (1987). An activity system is a systemic view of the relationships between the subject and the object of activity, mediated by cultural means (tools and signs or instruments) and by division of labour, rules and communities (ibid.).

Engeström (1987) expanded the analytic power of the activity system to add “nodes”, which include: (i) “*rules*”, which are the explicit and implicit regulations, norms, conventions and standards that constrain actions within the activity system; (ii) to analyse how and why individuals, or “*subjects*”, the individual or subgroup whose position and point of view are chosen as the perspective of the analysis, may act; (iii) *instruments*, also known as *tools* or *mediating artefacts*, used by the subjects can be material or conceptual, such as language, protocols, scientific methods and models that are as much tools as computers, phones as examples, (iv) “*division of labour*” for understanding the operational distribution of tasks among members involved in the activity; and (v) “*community*”, individuals and subgroups who share the same general object (Engeström and Sannino, 2010, p. 6). These nodes are also depicted in Figure 2.4, a model for second generation activity system analysis (ibid.).

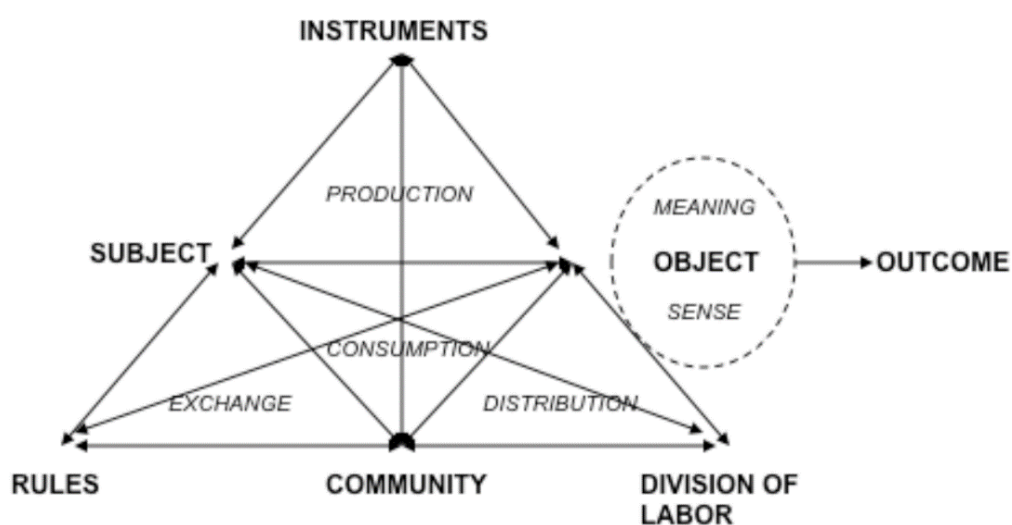


Figure 2.4: A CHAT second generation structure

Source: Engeström (1987), Engeström and Sannino (2010)

According to Cole and Engeström (1993), an activity system (Figure 2.4) is a basic unit of analysis that leads to important insights. First, it provides a conceptual map to the major loci among which human cognition is distributed. Second, it includes other people who must be taken into consideration simultaneously with the subject as constituents of human activity systems. These authors further elaborate that:

the fact that individuals (*subjects*) are constituted in communities is indicated by the point in the model labeled *community*. ... The relations between the *subject* and the *community* are mediated, on one hand, by the group's full collection of *mediating artifacts* and, on the other hand, by *rules* (the norms and sanctions that specify and regulate the expected correct procedures and acceptable interactions among the participants). Communities in turn, imply a *division of labor*, the continuously negotiated distribution of tasks, powers, and responsibilities among the participants of the activity system [italics added]. (Cole & Engeström, 1993, p. 7)

Virkkunen and Kuutti (2000, p. 301) asserted that, “when activities become institutionalized, they are rather strong and enduring”. They elaborate that CHAT emphasises the institutionalisation of social interaction, and that a unique element of CHAT is its emphasis on the object of human activity and the central role of artifacts.

The second generation of CHAT (Leont'ev, 1978; Engeström, 1987; Daniels, 2008; Engeström & Sannino, 2010) is of particular interest in this study because it identifies and examines the relationships and interactions between *subjects* (practitioners) and the *objects*, the goal or purpose of an activity they are working on, mediating tools and artifacts that are used, *rules* that govern engagement within the system, the *community* of practice involved in the system, and the *division of labour* among those working in the system, all taking place in a cultural and historically constituted activity system. Daniels (2008) draws attention to the multi-voicedness of activity systems and the way in which individual actors bring their own histories from social positions that they take up in the division of labour. The function of water ecosystems management through RDM, for water resource protection by the DWS, across various units and delegated institutions across the sector, and in cooperation with various

stakeholders, collectively bound by the common goal of sustainable water resource management for water security, can be seen as an activity system with interacting nodes.

Each individual taking part in a common activity has a slightly different view and interpretation of the *object* and purpose of the activity depending on factors such as the individual's position in the *division of labour*, his or her history in the activity, training and experience. Thus, the activity system is always internally heterogeneous and "multi-voiced". There are many competing and partly conflicting views. Even though some individuals are more powerful and central in the collective activity, no one individual can completely impose his or her view on others taking part in the activity. That is why no view should be taken a priori as privileged, 'right' or an official view when analysing the activity. Instead, the historical development of the activity and its object as well as the types of interpretation can be described (Virkkunen and Kuutti, 2000, p. 301).

Foot (2014, p. 29) elaborated that in such a multi-voiced structure of an activity system, "analysts employing CHAT need to acquire multiple perspectives in order to understand the activity under consideration". This view informed the approach in this study, as outlined in Chapter 3.

Another important feature of the chosen theoretical-analytical framework is its focus on *historicity* and the analysis of the historically formed contradictions (Engeström and Sannino, 2021), detailed in Section 2.4.3.3. As outlined in the introduction, water management in South Africa involves complex social and cultural aspects shaped over thirty years of history in South Africa's democracy, and even before, during the apartheid and colonial eras. This is important as "history is always present in human activity" (Engeström & Sannino, 2021, p. 7), and a system is likely to feature layers of historical forms of the activity in, for example, constraints and resources. Unveiling such layers for current role-players can be important, as layers of history may persist in routine actions, ways of thinking, material artifacts and in rules. If one tries to understand actions without historicity, "consequential phenomena are easily dismissed as arbitrary irrational features, even pathologies, of certain individuals or classes of people, to be eliminated or, at best, ignored" (Engeström & Sannino, 2021, p. 7).

Contradictions may exist, and are surfaced as potential sources of learning and change (see 2.4.3.3). The mediating tools and concepts that people engage with and use on a daily basis in an activity (in this case water ecosystems management), such as some documents analysed for this study, contain experiences, knowledge, and practices of people from the past. The methodology used, requires each activity in the system to be analysed as part of a collective and with the *social-historical context* of the *individual* and the *collective* in mind (Engeström, 1987; Virkkunen and Kuutti, 2000; Uden, 2007; Lindley 2014).

The current study drew on CHAT as a learning theory which I deemed appropriate for understanding water resource practitioners' collective activities in IWRM, specifically water ecosystems management through RDM. Given the period that RDM projects have been conducted (over a decade), and the systemic capacity challenges in the system, this study presumed that exploring learning in the system was of paramount importance for unlocking future efficiencies. However, the kind of learning needed to account for historicity of the system as a resource for identifying consequential phenomena (Engeström & Sannino, 2021). I used the second generation of CHAT as a learning tool for mapping case study activity systems and contextualising the interacting components or nodes for each activity system to identify *tools, rules, community, division of labour* and *subjects* or role-players in each. Activity systems facilitated interactions with role-players who provided their inputs, insights and feedback.

2.4.3.2 Expansive learning

In the third generation of activity theory, the basic model (Figure 2.4) is expanded to include minimally two interacting activity systems. Conceptual tools were developed to understand networks of interacting activity systems, dialogue, and multiple perspectives and voices (Engeström, 1987). The theory of expansive learning which forms part of the third generation of CHAT developed by Engeström (1987) was explored in the early stage of this study because Engeström and Sannino (2010, p. 3) found that it helped in “analysis of learning in non-traditional, hybrid and multi-organisational settings”. The application of this expansive learning theory in change experiment laboratories, with a core group of participants over a period of time, did not match the purpose of this study *to explore what new perspectives and*

learnings from RDM initiatives a social learning lens can unearth towards more for sustainable water ecosystems management in South Africa. In an expansive learning process, this would entail convening change laboratories focus groups among water ecosystems management practitioners in the water sector over time, which I deemed unfeasible at that stage in the study when much contextual understanding of the activity systems was still needed. It was also not feasible, given the complex social-ecological nature of water resources and the multi-organisational nature of the role-players involved. However, expansive learning as developed by Engeström (1987) and that informed CHAT in organisational learning contexts, involves ‘learning what is not yet there’ and is a dimension of the learning that expands understandings of the organisational issues in the activity system. Expansive learning was promising due to the desire for learning about water ecosystems management through RDM interventions and developing new understandings of it; revealing what was, “not yet there” at the start of the learning.

2.4.3.3 Contradictions

In the normal course of events, an activity system is constantly working through tensions and contradictions within and between its elements or nodes. Contradictions are historically accumulating structural tensions within and between activity systems (Engeström, 2001). Virkkunen and Kuutti (2000, p. 302) expanded on this by explaining that “contradictions are fundamental tensions and misalignments in the structure that typically manifest themselves as problems, ruptures, and breakdowns in the functioning of an activity system”. These contradictions are not necessarily problems or conflicts but could be sources of change and development. Foot (2014) argued that contradictions are not necessarily a weakness in an activity system. They can be a sign of richness, of mobility and of the capacity of an activity to develop rather than stagnate in a fixed and static mode. Foot (2014, p. 17) found that:

contradictions are present in every collective activity and indicate emergent opportunities for the activity’s development. They are lenses through which participants in an activity can reflect on the developmental trajectory of the activity system and understand its dynamics. Contradictions reveal the growing edges of the

activity system - the places where “growth buds” are able to form and expansive development take place.

A contradiction analysis is therefore a CHAT tool where inner contradictions of the activity systems are considered to be the driving forces and triggers of change, and development in the activity results in re-conceptualising the *object* (Engeström, 2001). These contradictions can therefore be analysed as the source of change and development of that system. By identifying the *tensions* and interactions between the nodes in one activity system, or between two adjacent activity systems, it is possible to reconstruct the system in its concrete diversity and richness, and therefore explain and foresee its development (Engeström, 1999). Suggesting that contradictions cannot be observed directly, Engeström and Sannino (2011) advise that it is important to approach contradictions from their manifestations. These authors (ibid.) identify four kinds of discursive manifestations of deeper underlying contradictions, including *conflicts*, *critical conflicts*, *dilemmas* in decision making and *double binds*, explained further in Section 3.5.3.

In summary, features of the CHAT theoretical-analytic framework that are particularly pertinent for this study are: (i) situating individual actors in collectives and recognising the social nature of meaning-making, learning and action; (ii) recognising the role of history in present-day features of systems; and (iii) recognising that contradictions are natural features of activity systems and possible points for growth and development (Engeström & Sannino 2011, 2021).

2.4.4 Why not communities of practice?

Vygotsky’s work prepared the ground for the development of theories that consider cognition and learning to be situated (Lave & Wenger, 1991) and expansive (Engeström, 1987, 2001). Learning is social, as outlined above in Sections 2.4.1 and 2.4.2, and in relation to work or other organised activities, may take place in, and be shaped over time by communities of practice (Wenger, 2009) and (other) activity systems. The concept of communities of practice held promise for studying RDM and has indeed been used by other environmental education researchers (Chanyau, 2023; Hiestermann, 2022). However, the community in the current

case study may not completely conform to the formation of a community of practice, where according to Wenger (1998) learning occurs when members actively participate in the community of practice.

Water resource protection interventions are undertaken by practitioners across various organisations in the South African water sector who together form a collective of specialists whom according to Wenger (2009) can be seen to be bounded by the common goal of sustainable water ecosystems management for water security in what Wenger calls a community of practice. However, communities of practice are described by Wenger (2009, p. 1) as a “group of people who share a concern, set of problems, or a passion for something they do and learn how to do it better as they interact regularly”. They are engaged in shared practice, with shared experiences, tools, vocabulary, lessons learnt and understandings that can sustain co-engagement in action (Wenger, 1998). People within a community of practice have been described as people who meet on an ongoing basis because they value the collaborative sharing of ideas, challenges, and attempting to find solutions. In the process they develop new knowledge and depth in their knowledge of the topic and learn new ways of doing things, new tools, and stronger relations between themselves (Wenger, McDermott and Snyder, 2002). Participants in the current study partially resonated with a community of practice, whereby knowledge sharing among these practitioners may not always be structured; and they may not engage in purposeful group collaborative sharing of ideas, challenges, and attempting to find solutions.

In addition, it was found that the concept of communities of practice by Lave and Wenger (1991) nor Wenger (1998) takes little consideration of the history of the present (Engeström, 2007). History has played an important role in water resource management in South Africa, as detailed in Section 2.3.1.1. As detailed in Section 2.4.3.1, on *historicity*, history is always present in human activity and layers of historically earlier forms of the activity can persist in routine actions as both constraints and resources (Engeström & Sannino, 2021). Therefore, based on the need for a strong analysis to probe more deeply a well-documented set of problems, I chose to use CHAT for my main theoretical framework.

2.4.5 Critical realism

Philosophical foundations (worldviews or paradigms) influence a study path in terms of methodological approaches. Maxwell (2012) asserted that all theories are grounded in a particular perspective and worldview, and all knowledge is partial, incomplete, and fallible. Various philosophies, including positivism, interpretivism, critical realism, and post-normal approaches can be applied in academic research. As research approaches, they have all been used for environmental management, environmental governance and environment and sustainability education research. Table 2.4 provides a summary of the way in which knowledge is produced and validated in positivist, interpretative, critical and post-normal approaches.

Table 2.4: Summary of knowledge production practices

Source: Rodela et al. (2012)

Dimension	Positivist	Interpretative	Critical	Post-Normal
Basic goal	<i>In search of truth.</i> Build upon current knowledge base and fill gaps in our understanding	<i>In search of actors' interpretations of the world.</i> Provide a rich picture of the interpretations of a given issue by different groups	<i>In search of transformations.</i> Provide input for empowering processes undertaken by practitioners	<i>In search of a negotiated agreement.</i> Provide scientific input for policy and decision-making
The nature of knowledge	Knowledge is universal	Knowledge is contextual	Knowledge is power	Knowledge is multifaceted
Most used mode of inquiry	Scientific method	Phenomenological inquiry	Reflective inquiry	Action research
Reasons for undertaking the investigation	Finding evidence (discovery, curiosity)	Understanding	Empowering	Problem solving
Type of evidence discussed	Mainly quantitative	Mainly qualitative	Mainly qualitative	Qualitative and quantitative
Researcher's role	Neutral outsider	Participant	Learning agent, participant	Advocate, participant
Degree of interaction with other research programmes	Lines are tightly policed: disciplinary differentiation	Lines are loose: inter-disciplinary	Lines are loose: inter-disciplinary	Lines are open: transdisciplinary
Audience	Peer community	Peer community	Peer community, practitioners and society	Extended peer community (stakeholders), policy and decision-makers

Positivist research is based on assumptions that reality is uniform and unchanging, and that knowledge accumulated about an object can be generalised to a wide range of cases; where the observer is posited as separate from the observed by scientific method, that includes observations, measurement, experimentation, formulation, testing and modification, (Kuhn, 1970). Positivist perspective is the grounding of controlled experiments which emphasise empirical evidence with the intent to uncover 'objective' patterns and regularities. These experiments have been and continue to be a widely used methodology in the natural sciences. Experimental methodology has been increasingly adopted by social scientists in the past few decades as it enables the researcher to explore and test hypotheses about human behaviour (Falk & Heckman, 2009).

Interpretive research also known as subjective refers to interpretative research approaches that focus on the meanings, experiences, feelings and interpretations that people attach to particular phenomena. This approach has underpinned important studies in the social sciences, especially those studying cultural beliefs, values and practices, as examples of phenomena. The assumption in interpretivist approaches is that the same phenomena can be interpreted and understood in various ways and that any interpretation or experience is highly contingent on a particular time and cultural context. This approach emphasises the researcher's role in the knowledge creation to be central as an interpreter in the process (Biggs et al., 2022). Understandings of interpretative research have developed from the past where it was seen to assume a reality that is socially constructed and highlights (foregrounds) the need for the researcher's role to act as an observer, seeking simply to capture the interpretations of different groups about the issue in its natural setting (Heidegger, 1982).

A post-normal research approach on the other hand tends to be issue-driven, policy relevant, transdisciplinary and emphasises the improvement of an issue. In this case, the researcher does not operate alone under firmly defined disciplinary domains but is engaged in collaboration with an extended community whose input is sought during problem formulation, or later, for the purpose of knowledge validation (Funtowicz and Ravetz 1990, 1993; Petersen, Cath, & Hage, 2011).

This qualitative study is informed by a critical realist philosophy. The origin of critical realism has been attributed to the work of Roy Bhaskar (Bhaskar, 1979) and further elucidated by various authors including Sayer (2000), Norrie (2010) and Maxwell, (2012). Bhaskar (2008, p. 198) provides an introduction that “the world is stratified”, and that transcendental realism regards the objects of knowledge (as produced in the social activity of science) as the structures and mechanisms that generate phenomena. These objects are neither phenomena (empiricism) nor human constructs imposed upon the phenomena (idealism), but real structures which endure and operate independently of our knowledge, our experience and the conditions which allow us access to them. In empiricism, the objects of knowledge are considered as structures, not events; while in idealism, they are intransitive. As such, both knowledge and the world are seen as structured, differentiated and changing; existing independently; and experiences and the things and causal laws to which it affords us access are normally out of phase with one another (Bhaskar, 2008, p. 15).

Critical research does not exclude the researcher’s personal ambitions, values and ethical principles. They are seen to be functional for the research process that he or she is engaged in (Rodela, Cundill, & Wals, 2012). Critical research seeks to unveil interpretations of reality through a power relations lens oftentimes with a normative purpose of overcoming power imbalances and social inequities (Hart et al., 1994; O’Hara, 1996; as cited in Rodela et al., 2012).

The *realist* in the critical realist philosophy assumes that social and natural reality exists independently of our cognitive processes, whether or not human beings can gain access to it or understand it (Maxwell, 2012). Firstly, critical realism makes the “ontological assumption that there is a reality but that it is usually difficult to apprehend” (Easton, 2010, p. 128). Secondly, critical realist ontology is stratified or layered and it distinguishes three levels of reality (see Figure 2.5), the real, the actual and the empirical (Easton, 2010; Norrie, 2010). The *real* stratum encompasses things that exist independently in the natural real world and those that were created by society in social interactions, “experiences and events, and the underlying mechanisms that generate events and make them available to experience” (Norrie, 2010, p. 8). The *real* includes the *entities*, such as organisations, which have powers

to act and are liable to be acted upon by others. These entities can also have internal *structures*, such as departments and individuals, which in turn, have their own *causal powers*, inherent to them (Sayer, 2000; Saxena, 2019; Easton, 2010).

Easton (2010, p. 128), explains that entities have relationships among themselves which are defined as necessary in terms of our understanding of their powers. As an example, buyers and sellers have necessary relationships by virtue of the designations in their act by buying or selling. Alternatively, they may also have a contingent relationship, that is, they may or may not have such relationships. The relationship among entities that is thought to cause the events is called a “mechanism”. Thus, we will always be surmising about the nature of the real (ibid.).

Thirdly, the stratum of the *actual* is a subset of the real and includes the events that actually occur due to the enactment of the causal powers of structures and entities. These events may or may not be observed by humans. Finally, the stratum of the *empirical* is a sub-set of the actual and consists of events experienced through our senses which can be captured, measured or recorded (Bhaskar 1975, 1989).

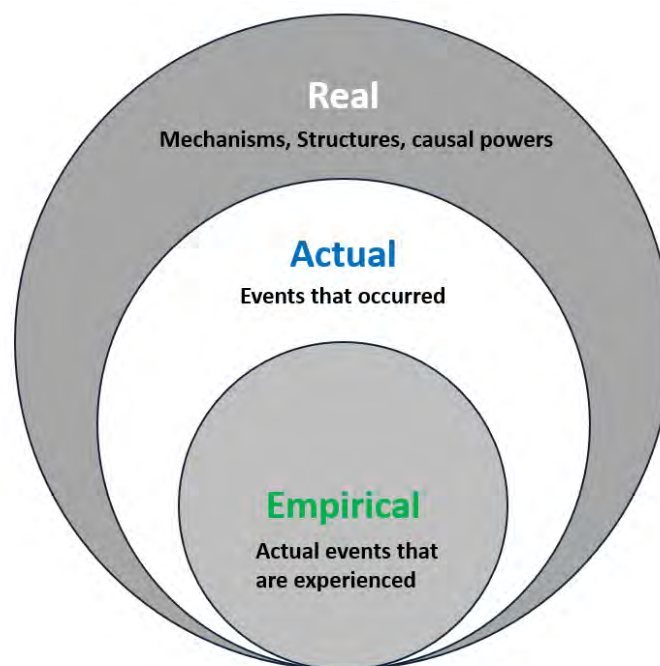


Figure 2.5: Three levels of reality in critical realist ontology

Source: adapted from Bhaskar (1975, 1989); Easton (2010); Saxena (2019)

A critical realist study therefore aims to explain a given set of empirically observed or deduced events by uncovering underlying mechanisms which, if they existed and were enacted, could have produced these events (Bhaskar 1975, 1989; Easton, 2010; Saxena, 2019).

Mingers (2015) outlined the Realist Theory of Science, which was described by Bhaskar (1978) as the fundamental concepts from which the initial version of critical realism was built. Bhaskar also recognises the distinction between closed and open systems, whereby the social world is inherently open. The claim is also made that both nature and our knowledge of it are stratified and differentiated (Bhaskar, 1978). Sayer (2000, p. 15) elaborated that in “open systems” of the social world, the same causal power can produce different outcomes, according to how the conditions for closure are broken. As an example, economic competition can prompt firms to restructure and innovate or to close. Sometimes, different causal mechanisms can produce the same result; for instance, you can lose your job for a variety of reasons. Such regularities as they also occur in social systems are approximate and limited in duration and are usually the product of deliberate efforts to produce them, through devices such as disciplinary regimes, for example, regarding the start and end of the working day, and machine-pacing of work (Sayer, 2000). In essence, there is more to the world than patterns of events; it has ontological depth, whereby events arise from the workings of mechanisms which derive from the structures of objects, and they take place within geo-historical contexts (ibid.).

Critical realism attempts to usher in a more inclusive totality that can inform transformative praxis and make it more rational in open systems; it is a philosophy of the left in so far as it favours more inclusive totalities and what it is doing is isolating absences that include social inequities and imbalances that exist in social life, and it is this that powers the system (Bhaskar & Hartwig, 2010, p. 205). Moreover, a critical realist philosophy is seen by Mingers (2015) to align well with real-world problems which are characterised by complex, multi-factorial causes, similar to a complex systems worldview, as is the case of RDM for water resource protection. Critical realist arguments as coined by Bhaskar (1979) are powerful in establishing the principle that social science is intrinsically and unavoidably evaluative and thereby committed, in principle, to critique of the status quo.

In this study, a critical realist orientation resonates with my positionality as the researcher in the selected case studies and does not exclude personal *ambitions, values and ethical principles*, which are seen to be *functional* for the research process that I am engaged with. This is due to a deep entrancement in the system as a member of the RDM practice, as well as a citizen of the country, who has historically experienced the inequality of water distribution, and still observing it today. This orientation will support the need to remain objective and critical of the object of analysis, such as RDM for water resource protection.

The potential value of critical realism in the current study is in its ability to provide explanatory critique, with ontological depth that goes beyond the actual and the observed to the causal mechanisms that are invisible, thus rich in explanatory power (Bhaskar, 1979).

My choice of critical realism as the philosophical underlabourer of CHAT (epistemological and ontological lens) for this study informed the research data generation, methodologies and analytic approaches I used in this critical realist, social learning orientated, organisational learning enquiry, as will be explained in Chapter 3.

2.5 CONCLUSION

Given that the South African water sector challenges have been widely documented and studied, a different approach in the form of applying a social learning lens can potentially assist in shifting perspectives and bringing a new understanding of the challenge. As outlined by Glasser (2007), it is through acquiring new information, or exploiting existing information, that we have the opportunity to test our values and concerns against our understanding of reality and, if warranted, we can take measures to rethink our values, or realign our behaviour and action, or do both. Therefore, this study draws on theories from educational, learning, development and organisational sciences to probe learning anew in a natural resource management context.

The approach that will be followed in this study is surfacing individual experiences within organisational contexts and within a collective with team members over time. This was deemed to be particularly helpful for the water value chain that spans across various

institutions at local, national and parastatal levels. This study draws on the concept of social learning and the theoretical framework of activity theory, specifically CHAT, which emphasises the cultural and historical dimensions of the activities in organisational systems. While CHAT studies in environmental education have often involved change laboratories for expansive learning, these will not be attempted in this study, due to the need to first understand the system and existing learning within the system more deeply. This study, therefore, focusses on social learning among the role-players, individuals and organisations, in an activity system that aims to address the shared object of sustainable development and management of South Africa's water ecosystems. The methodology followed to achieve this, is described next.

3. CHAPTER THREE: STUDY APPROACH, DESIGN, METHODS AND ANALYSIS

3.1 INTRODUCTION

This chapter introduces the study approach, design, methods, data analytic framework and research ethics. The study approach in turn explains the theoretical and philosophical framing of the research, building on the literature reviewed in Chapter 2, as a critical realist exploratory study using a social learning lens. The study design outlines the case study design and three research objectives, each framing the three study phases. The study methods employed multiple qualitative data sources which were documents, semi-structured interviews and in-field discussions at a conference, workshop and symposium.

The research captured data with respect to ongoing and past events, asking at all times why they happened or are happening, and taking into account the problems and issues associated with interpreting the empirical data back to the real entities and their actions. The research process was one of continuous cycles of research and reflection. A multi-layered analysis approach involved inductive and deductive analysis of data to identify factors that address pre-determined themes in the key research questions, as well as new or emerging themes (Mitchell, 2013). Lastly, I gained 'multiple perspectives' from role-player experiences and the critical realist theory provided for explanation building to aid understanding of each case study in depth (Yin, 2009). Explanation building for surfacing causal mechanisms was conducted through retroductive analysis (see Section 3.5.4). The findings identified mechanisms that can be regarded as having caused the observed events.

3.2 STUDY APPROACH

My study involves a critical realist approach to case study research to address the broad research aim or question (Easton, 2010), introduced in Section 1.4 as *what new perspectives and learnings from Resource Directed Measures (RDM) initiatives a social learning lens can unearth towards more sustainable water ecosystems management in South Africa*. This research question identified a phenomenon of interest, in terms of discernible events, and asks what causes them to happen. The key entities involved, their powers, liabilities, necessary and contingent relationships, were identified.

The study uses a critical realist under-labouring, seeking to surface underlying mechanisms by exploring the manifestations of contradictions in the second generation of Cultural Historical Activity Theory (CHAT, Leont'ev, 1978; Engeström, 1987; Daniels, 2008; Engeström & Sannino, 2010) introduced in Chapter 2. The strength of such an approach is in its explanatory power to answer the 'why' and 'how' questions, while generating credible evidence and new perspectives on what was shared by research participants. Critical realism is well suited to this case study research as it provides objective understanding and a deeper analysis of why things are the way they are (Mingers, 2011).

3.3 CASE STUDY RESEARCH DESIGN

A case study research design was undertaken to address the research aim *to explore what new perspectives and learnings from RDM initiatives a social learning lens can unearth towards more sustainable water ecosystems management in South Africa.*

A case study research design focuses on a phenomenon within its real-life setting (Yin, 2014). Hancock and Algozzine (2006, p. 16) found such a natural context to be "bounded by space and time" and the case study method to be richly descriptive, due to "grounding on extensive and diverse information sources". The diverse information sources jointly bring to life the complexity of the many variables inherent to the phenomenon being studied (ibid.). Case research involves investigating a small number of social situations about which data are collected using multiple sources and developing a holistic description through an iterative research process (Easton, 2010). In this study case, the focus is on the practice of water ecosystems management through RDM for water resource protection within the context of the Department of Water and Sanitation (DWS) institution.

Case study research is expected to be data rich from observations, evidence artefacts, interview quotes and written records (Yin, 1997). Insights are generated in the phenomenon's real-life context leading to rich, empirical descriptions from in-depth research (Dubois & Gadde, 2002; Eisenhardt & Graebner, 2007; Saunders, Lewis & Thornhill, 2016). This study generated data by analysing written records and conducting semi-structured interviews and in-field discussions with key participants. It employed qualitative data which is suitable for

exploring the study case in its natural setting in practice (Yin, 2009). An exploratory case study design was chosen to provide a means of asking open questions to discover 'what' is happening and 'what has been learned' to gain insights about the study topic. This was particularly useful for clarifying the understanding of the research phenomenon and it can be conducted in various ways including literature, expert interviews or focus group interviews (Saunders, Lewis & Thornhill, 2016). Due to the critical realist orientation, the study further sought to unearth underlying mechanisms and establish causal factors thus answering 'why' and 'how' explanatory questions (Saunders, Lewis & Thornhill, 2016).

Case study research is suitable in situations where: (a) the main research questions are "how" or "why", yielding explanatory responses; (b) a researcher has little or no control over behavioural events; and (c) the focus of study is a contemporary, as opposed to entirely historical, phenomenon (Yin, 2014). These characteristics of case study research resonate well with my intention to examine water ecosystem management in its real-life context. The practice of RDM determination and implementation in South Africa, in water resource protection and, specifically, ecosystems management, is nested in the overall water resource management practice in South Africa. Within the overall RDM case, there are activity systems at the National Office and three provincial offices, with two of these found in the Mpumalanga case. Yin, (2009) defined such studies, that probe cases that are made up of cases within a case, as multiple embedded case studies.

As outlined in Section 1.4, my research objectives are to:

- identify enablers and challenges relating to policy, institutional and operational factors in the context of RDM;
- examine the implementation experiences of role-players and identify their associated learnings derived from participation in identified RDM interventions;
- draw lessons and recommendations regarding organisational learning in the context of RDM policy implementation.

This study was designed into three phases where each phase addressed each of the above study objectives, which were then organized together to answer the overall research

question. According to Cronin (2014), a multi-layered analysis approach promotes cross-case analysis and allows the researcher to observe the development of themes in each phase. Table 3.1 provides a summary of the design, and the methods used for each phase in-this study.

Table 3.1: Study design and methods

Source: Author

Study Phase	Study design and method
Phase 1 addressed objective 1: To identify enablers and challenges relating to policy, institutional and operational factors in the context of RDM.	<u>Step 1: Document analysis</u> • data sourced from desktop review of publicly available credible documents; • documents used to derive information on, and status quo of water ecosystems protection in South Africa, specifically RDM projects undertaken to date; - information analysed, iteratively, to derive enabling and challenging factors in each theme of policy, institutional and operational factors, through a combination of content and thematic analysis, tracing the history of water ecosystems management, and identifying policy, institutional and operational factors; • formulate a holistic picture of empirical study data from information derived from past and present RDM project reports; • formulate analytic memos to derive key factors emerging in policy, institutional and operational enablers and challenges; • further analysed emerging themes by looking across them and grouping them to derive analytic statements.
	<u>Step 2: Mapping document analysis information into activity systems</u> • activity system analysis, identifying tensions and surfacing contradictions derived from document analysis.
	Steps 1 and 2 resulted in insights into enablers, challenges and contradictions relating to policy, institutional and operational factors in RDM activity systems. This information was taken into semi-structured interviews with role-players as mirror data to obtain inputs based on their lived experiences in the activity systems.
Phase 2 addressed objective 2:	Engagements with role-players • semi-structured interviews conducted, based on the study objectives and drawing from the CHAT theoretical framework (see Appendix 5 Annexure A);

Study Phase	Study design and method
To examine the implementation experiences of role-players and identify their associated learnings derived from participation in identified RDM interventions.	• interviews with role-players in the activity systems of the three cases, National Office, KZN and MP Provincial Offices; • in-field group discussions at a conference, workshop and symposium. • transcripts similar to data logging templates, recommended by Yin (2009), compiled to capture interview discussions for building a chain of evidence towards explanations; • transcripts shared back to role-players for review and further input; • immersing myself in the data, detailing each case and becoming intimately familiar with it for case analysis and cross-case comparison (Cronin, 2014); • inductive analysis of semi-structured interviews and workshop discussions to explore emerging factors: - firstly, data was sequentially grouped on data cards, per question, across the role-players in each activity system, to provide a means of listening to all voices per interview question; - Secondly, cross-referencing role-player insights to identify relationships between experiences shared, allowing for more meaningful data synthesis; - qualitative data was analysed and key ideas, terms, and phrases categorised into data 'themes', used for surfacing new insights and learnings; • activity system mapping with role-player inputs and contradiction analysis of role-player experiences.
Phase 3 addressed objective 3: To draw lessons and recommendations regarding organisational learning in the context of RDM policy implementation.	Findings analysis to derive learnings • consolidation of findings from all the above analytic frames; • retroductive analysis: - probing further on document analysis findings, role-player experiences and CHAT manifestations of contradictions – digging deeper, using a critical realist lens and deriving causal mechanisms from the empirical findings, at the level of 'the real' in critical realism; - surfacing causal mechanism and deriving emerging themes. • consolidating findings, drawing lessons and recommendations; and • deriving implications for organisational learning from all study data.

3.3.1 Case study areas

Wisker (2008) cautioned that although a situation can be explored in-depth in a case study, one cannot generalise from one case and they suggest that this can be overcome by exploring a few cases from which a range of interpretations can be established. In this study, three case study areas were purposely selected to contrast between an area with a functional Catchment Management Agency (CMA), the Mpumalanga Province and an area without a functional CMA, KwaZulu-Natal (KZN) Province and in relation to their overarching National Office (DWS head office). In addition, these areas were selected due to the existence of historically determined RDM projects to showcase subsequent implementation experiences of role-players. The selected study sites are described next, with further motivation for the choice of case.

3.3.1.1 Case study 1: National Office RDM determination

The RDM determination mandate of the Chief Directorate: Water Ecosystem Management (previously called Resource Directed Measures) in the Water Resource Management Branch was selected as case study 1. The aim of this Chief Directorate is to develop and implement measures for protection and conservation of water resources through determination of the Reserve, Water Resource Classes, Resource Quality Objectives and Sources Directed Studies as part of the unit's water ecosystems management function (South Africa. DWS, 2022b).

The Chief Directorate currently consists of three Directorates, illustrated in Figure 3.1, the third added in 2018 (Sources Directed Studies), and is where I am currently employed. The overarching RDM determination study case is undertaken within the Water Resource Classification and Reserve Determination Directorates as illustrated in Figure 3.1.

Over time the Chief Directorate has undergone structural changes, as demonstrated by the older organisational structure in Figure 3.2, which preceded that in Figure 3.1. In the past, RQOs were the responsibility of the Directorate: RDM Compliance. Over time, the function was merged into the Directorate: Water Resource Classification and the structure as illustrated in Figure 3.1 was the operational structure at the time of study.

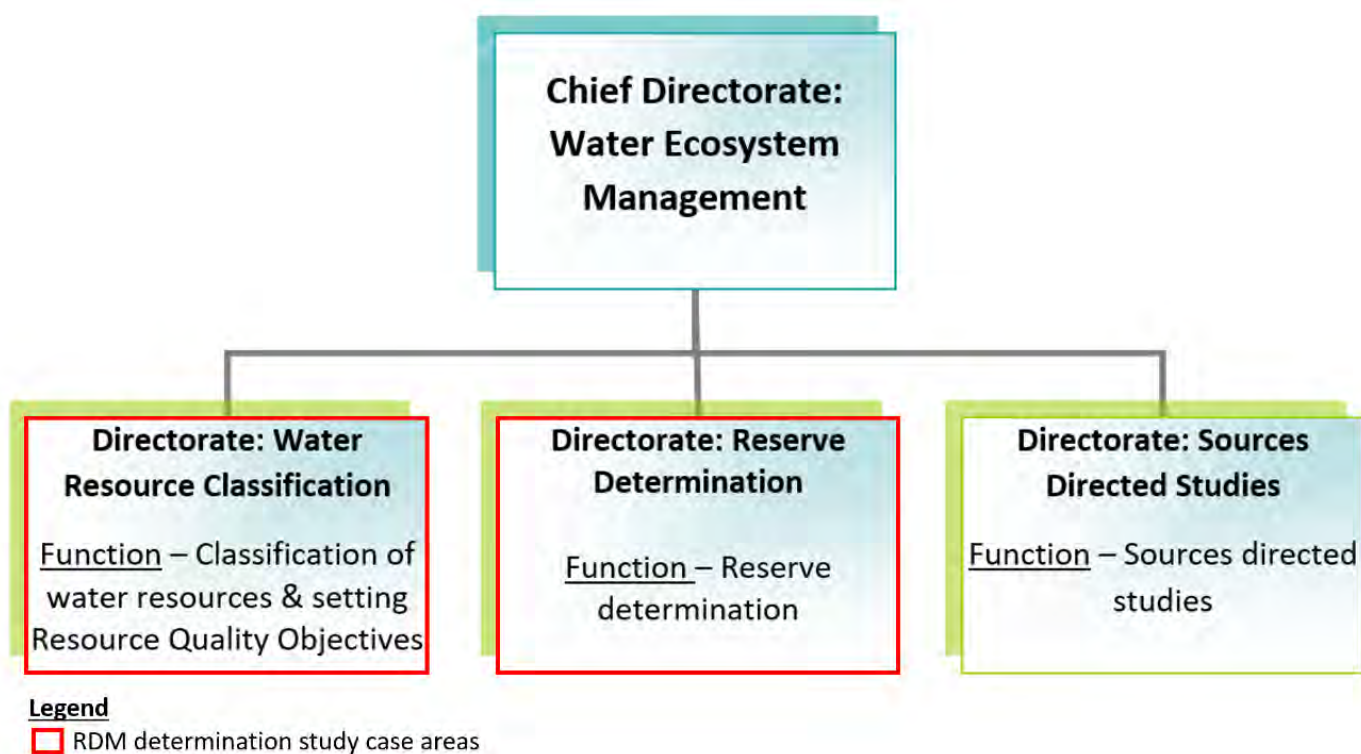


Figure 3.1: Current structural composition of the DWS Chief Directorate Water Ecosystems Management – Case study 1
 Source: Adapted from South Africa. DWS (2022b)

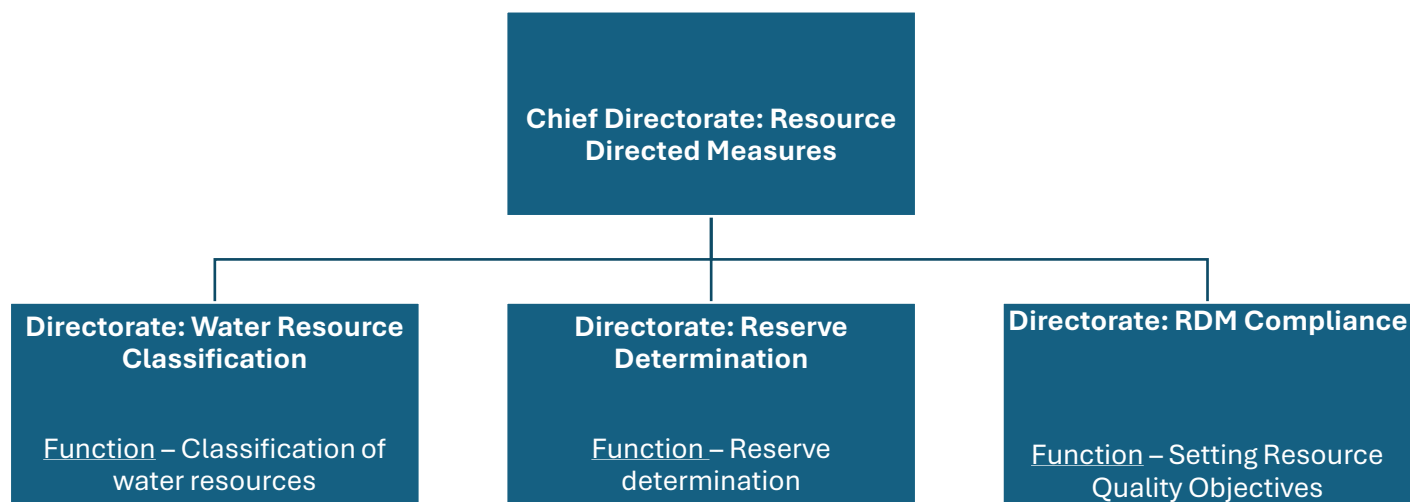


Figure 3.2: Old structural composition of the DWS Chief Directorate Water Ecosystems Management
 Source: Adapted from South Africa. DWA (2013b)

As illustrated in Figure 3.1 and 3.2, RDM, including Water Resource Classes, Reserve and RQOs, are tools that contribute to water resource protection within the broader IWRM practice. The Chief Directorate: Water Ecosystem Management constituted case study 1 in this study because the RDM determination process for all WMAs in the country is conducted by this unit. RDM projects are undertaken in catchments where they involve multiple stakeholders within each WMA (South Africa. Department of Water Affairs [DWA], 2012). These stakeholders range from government officials from various institutions (see Section 2.3.2) with varying expertise such as Scientists, Project Managers, Engineers, Environmental Officers, Catchment Managers; to Scientists in consulting teams, water users and civil society, among others (ibid.).

Unlike case study 1, which is focused on RDM determination of projects, the same process, irrespective of the geographic or WMA area, case studies 2 and 3, outlined next, focus on the implementation of the determined RDM, in each case study area.

3.3.1.2 Case study 2: KZN Mvoti to Umzimkhulu RDM project

The KZN Mvoti to Umzimkhulu RDM project, titled *Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkhulu WMA Water Management Area* (now called Pongola-Mtamvuna WMA), was selected as a case study. The three-year RDM determination project was initiated in September 2012 and completed and gazetted in December 2017. I regarded this as a suitable initiative in which to achieve my research objectives, particularly regarding learning. This was the first project where Classification was undertaken jointly with Reserve and RQOs determination. Historically (in previous projects prior to the Mvoti), these RDM components were determined separately. The integration was potentially a demonstration of learning leading to system changes over time. It is such developments, observations and key learnings taking place (or not), that this study aimed to bring to the fore and examine more deeply. I was the Project Manager for this project 10 years ago and I therefore drew on my personal experience while seeking new information and insights. I was also curious about learnings from this study, and progress in its implementation. The implementation of the RDM

determination outcomes is the responsibility of the DWS KZN provincial office, in the absence of a fully functional Catchment Management Agency (CMA).

The Mvoti to Umzimkulu WMA, illustrated in Figure 3.3, lies along the eastern coast of South Africa, predominantly within the Province of KZN, and borders on Lesotho to the west. The main urban areas in the WMA are Durban and Pietermaritzburg with a strong population growth projected for the Mgeni sub-area, aligned with expected economic growth in the area, and increasing urbanisation. The population in the rural areas was estimated by DWAF to remain relatively unchanged (South Africa. DWAF, 2004). This WMA experiences a humid climate, with a mean annual precipitation of 800 mm to 1 500 mm. It stretches from the Drakensberg Mountains in the west at an altitude of over 3000 m, and drops to sea level in the east over a comparatively short distance of 150 km.

The Mvoti to Umzimkulu WMA is rugged and is characterised by steeply sloped river valleys in the inland areas. Moderate slopes comprise only 3% of the WMA. These flatter areas are mainly subject to intensive agricultural activities (South Africa. DWAF, 2004). The Mvoti to Umzimkulu WMA consists of two large river systems, the Umzimkulu and Mkomazi, both rising in the Drakensberg. Two medium-sized river systems, the Mgeni and Mvoti, rise in the Natal Midlands and have been largely modified by human activities, mainly, intensive agriculture, forestry and urban settlements. The Mgeni River is the main source of water for the Durban and Pietermaritzburg areas, and it is fully regulated by several large dams in the catchment. It is augmented with engineered transfers from the Thukela WMA (ibid.). Various degrees of development apply to the remainder of the surface resources in this WMA. Several smaller river systems, the Mzumbe, Mdloti, Tongaat, Fafa, and Lovu Rivers, also exist within the WMA (South Africa. Department of Water Affairs and Forestry [DWAF], 2004b). Eight key tertiary catchment areas exist within the WMA, including Mvoti, Mdloti, Mgeni, Mlazi and Lovu, Mkomazi, Mpambanyoni to Mzumbe on the south coast), Umzimkulu, and Mtamvuna (South Africa. DWA, 2012). Rural water supply comes from surface water, which includes spring flow, due to the perennial nature of streamflow in the WMA, with only minimal groundwater abstraction (South Africa. DWAF, 2004). A diverse range of economic activities are undertaken in the WMA. Subsistence and commercial farming dominate in the rural areas,

with extensive cultivation of sugar cane along the coast, and commercial forests in the higher rainfall areas. The Durban metropolitan area is the second largest commercial and industrial hub in the country, and it is surrounded by developments along the coast and inland towards Pietermaritzburg (South Africa. DWAF, 2004).



Figure 3.3: The Mvoti to Umzimkulu WMA – Case study 2

Source: South Africa. DWA (2012)

3.3.1.3 Case study 3: Mpumalanga Inkomati RDM project

The Mpumalanga Province Inkomati RDM project, titled *Determination of Water Resource Classes and Associated Resource Quality Objectives in the Inkomati WMA*, was selected as case study 3. The two-year RDM determination project was initiated in April 2013, completed and gazetted in 2016. That project involved only two components of RDM, namely Classification and RQOs. Reserve determination had been undertaken previously in 2006 and 2010, for different parts of the study area. The Inkomati RDM project inception report noted that the 2006 Reserve Ecological Water Requirement (EWR) information as outdated in relation to hydrology changes, needing to be updated for the 2013 RDM determination (South Africa. Department of Water Affairs [DWA], 2013b). I selected the Inkomati RDM project area as a case study due to a fully functional CMA that undertook the implementation of the determined Classes, Reserve, and RQOs.

The Inkomati WMA is in the north-east of South Africa. In the previous WMA demarcation, it consisted of three main river catchments, the Komati, Crocodile and Sabie catchments (see Figure 3.4). A part of the Kingdom of Eswatini (formerly Kingdom of Swaziland) falls within the Komati catchment and although the classification process does not apply to this country, its water resources and water use was taken into account when classifying the resources upstream and downstream due to the hydrological connectivity. All three rivers flow into neighbouring Mozambique to form the Incomati River, which flows into the Indian Ocean just north of the city of Maputo. Rainfall in the WMA is seasonal with relatively high summer rainfall and zero or minimal rainfall during winter. Rainfall varies from over 1 000 mm/annum in the high lying area in the West to as low as 500 mm/annum in the East (South Africa. DWA, 2013b).

The main urban areas in the Inkomati WMA are Nelspruit with surrounding towns of Kanyamazane and White River. The sprawling urban and semi-urban area is centrally located near the Crocodile River. Other significant towns are Barberton, Hazyview, Sabie, Graskop, Acornhoek, Carolina and Badplaas. Within the WMA there are large areas of rural or semi-urban development, with large populations of mostly unemployed inhabitants (South Africa. DWA, 2013b). The Bushbuckridge area is a good example of this type of development.

Intensive irrigation farming is practiced throughout the WMA and especially in the lower reaches of the Komati and Crocodile Rivers. Sugarcane is the dominant crop, but citrus, tropical fruit and nuts are also found. Agriculture is by far the largest water use sector in the WMA. Forestry is practiced in the high rainfall areas on the upper plateau. Indirect water use by forestry, through streamflow reduction, is the second highest usage of water in this WMA (ibid.).

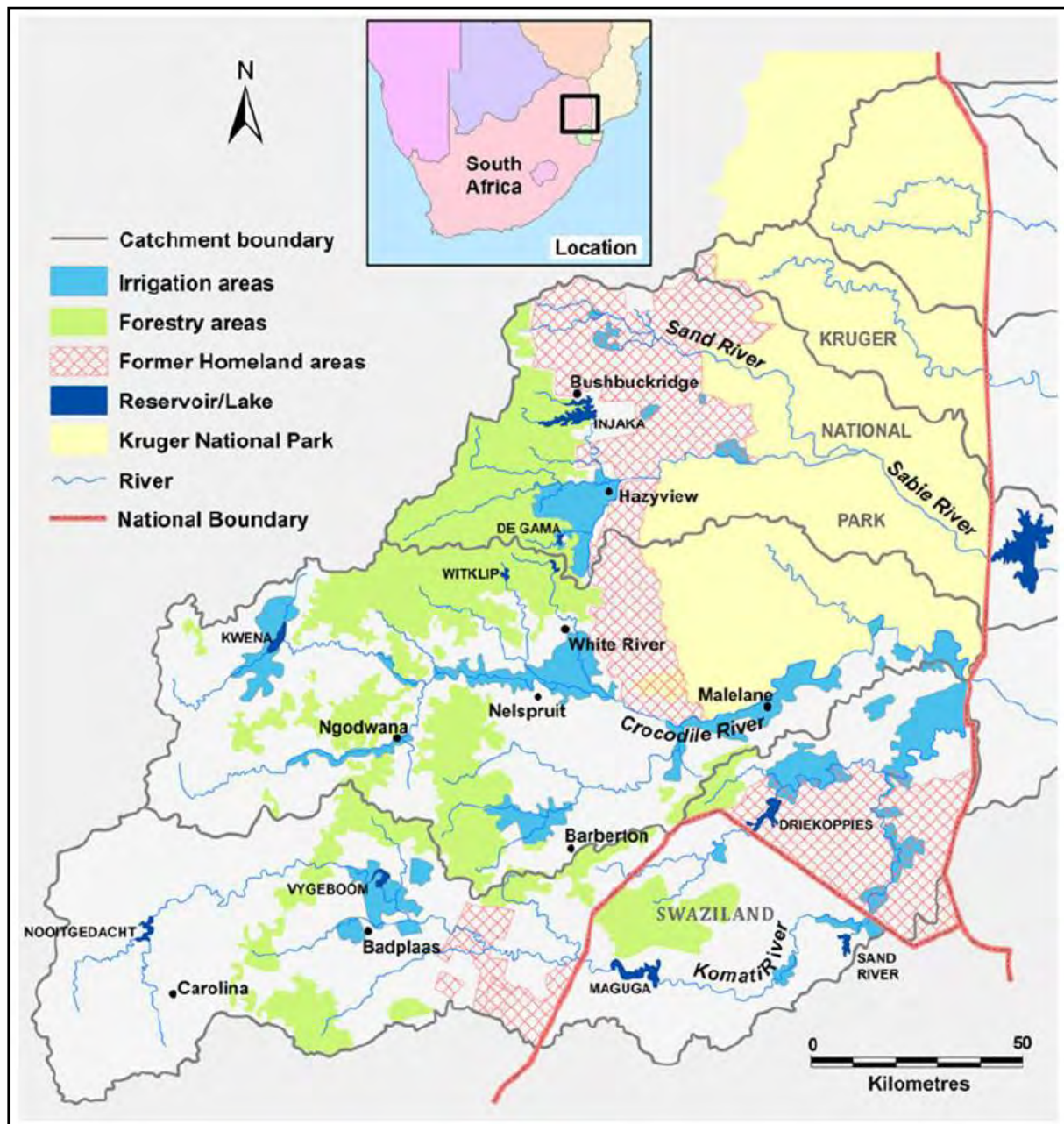


Figure 3.4: The Inkomati WMA – Case study 3

Source: Brown (2014)

3.4 STUDY METHODS

Data and methodological triangulation are used in qualitative research to strengthen the validity of the findings (Fusch, Fusch, & Ness, 2018). In this study, data was triangulated from multiple data sources, including documents, semi-structured interviews and in-field role-player engagements. Documents were analysed in Phase 1 and it provided both historical and contemporary information on the study cases. In Phase 2, semi-structured interviews were conducted with multiple role-players who hold different vantage points in the system, based on the number of years of experience in the system, and hence varying levels of expertise, and different roles in the Department of Water and Sanitation (DWS) national and provincial (commonly known as regional offices) offices. Furthermore, in-field role-player engagements were facilitated through presentations delivered at sector events, including a conference, workshop and symposium. These provided access to, and inputs from participants from different organisations. The sections that follow provide details on each phase and its associated objective, methods and data sources.

3.4.1 Document analysis method: study phase 1

Objective 1 of the study was *to identify enablers and challenges relating to policy, institutional and operational factors in the context of RDM*. Qualitative document analysis (QDA), guided by Altheide (1996, 2000), Bowen (2009), and Wach, Ward and Jacimovic (2013), was used to identify policy, institutional and operational RDM factors, and associated contradictions. These factors are the three complementary elements proposed by the IWRM framework (GWP, 2000). These include the enabling environment provided for in policies, legislation and regulations, institutional roles and functions, and management instruments.

The documents sample (see Table 3.2) consisted of printed and electronic documents, all publicly available, and deemed credible. It included documents that inform the mandate and outline the steps for water resource protection through RDM, and a variety of official and commissioned reports on its determination and implementation. My insider positionality, as a water ecosystems management practitioner (see Section 1.7) in the RDM Chief Directorate at the DWS, assisted greatly in knowledge of public platforms where relevant documents could be sourced.

Sections 3.4.1.1 to 3.4.1.6 provide a step-by-step outline of the process of document analysis undertaken.

3.4.1.1 Document inclusion criteria

In light of objective 1, an initial step focussed on selecting policy, institutional and operational documents to be included in the study. Inclusion criteria adopted from Wach, Ward and Jacimovic (2013) was that documents must be publicly available, published by credible organisations in the South African water sector and contain required water policy, institutional and operational information to elicit enablers, challenges and implementation learnings over time. These document selection criteria were aimed at ensuring ethical, credibility and authenticity considerations were upheld.

3.4.1.2 Document collection

The second step entailed collecting several types of relevant documents, for examples reports, noting the format and identifying relevant information by:

- a) reviewing documents to find, select, appraise and synthesise data relevant to the study, and to identify meaningful text, relevant to water ecosystems protection and RDM.

3.4.1.3 Extant data sourced from documents

Guided by Labuschagne (2003), the nature of the qualitative data collected for document analysis yielded detailed excerpts, direct quotations or entire passages, listed in Appendix 14.

Data extracts are captured in the form of snippets as evidence of the actual data sourced across all the documents selected and collected. Data was collected specifically selected on the basis of relevance to study topic in a systemic and reflexive process to optimally position it for analysis.

Appendix 14 provides the raw data from selected documents. A summary of this document list and coding is provided in Table 3.2.

3.4.1.4 Document data generation and articulating key areas of analysis

Key considerations in preparing the documents for data generation and analysis included the types of data sourced and its “contextual positioning”, awareness of the “context from which the source data is sourced and the one in which it exists” (Ralph, Birks, & Chapman, 2014, p. 1). To assist the reader with the contextual positioning of the selected documents collected for analysis, Appendix 14 provides details of the documents coding numbers, its source, publication date, author(s) and the reasons for the inclusion of this document. It also provides snippets on the study specific data extracted from the document.

The main data sources solicited to respond to objective 1 were the extant documents (see Figure 3.5), defined by Charmaz (2006) as data that was produced for purposes other than the current research, although relevant to the study.

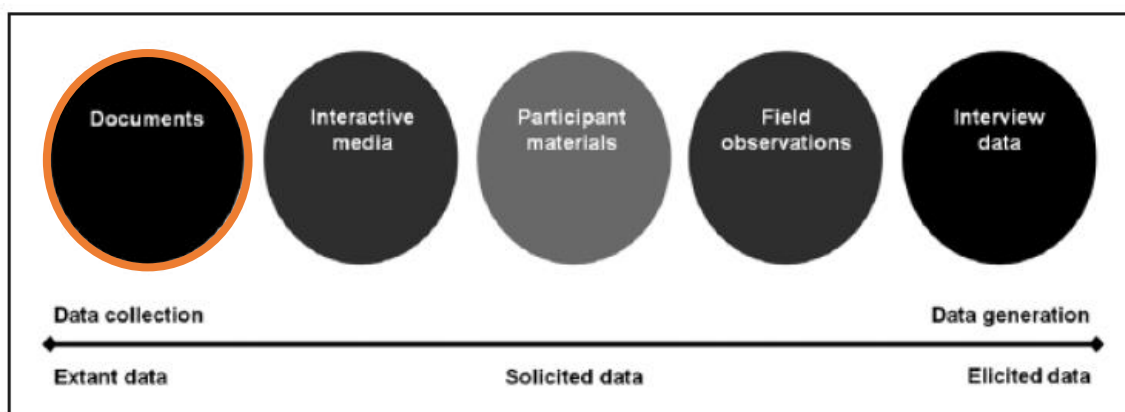


Figure 3.5: Spectrum of extant data and elicited data

Source: Ralph et al. (2014)

All documents were reviewed and evaluated for key information pertaining to water ecosystems management. During data generation, each document was considered in a reflexive way that placed them as data sources rich with purpose, intent, interpretation, and context, with the intention of finding out ‘what is going on’ and to establish an optimal entry point to analysis (Ralph et al., 2014). Guided by the authors (ibid.), many questions ought to be answered, either explicitly or implicitly, such as the who, what, when, where, why and how of context, to develop a deeper understanding of how to position the generated data for analysis. Each document was considered using this questioning approach and this helped me

with the selection of credible documents. Table 3.2 demonstrates the positioning of each document as a data source, in its own unique context.

3.4.1.5 Summary of sourced documents and their coding numbers

Document coding entailed the listing of several categories to guide data generation and drafting the data points (see Chapter 4). Table 3.2 provides a summary of all the documents collected in the study, with codes and descriptions. The document coding exercise involved grouping documents and sense checking the meaningfulness of the code names, so that the source of the data would not be lost as data extracts were analysed. The document coding legend is: abbreviated document type (category 1) – abbreviated document type subcategory – document number within the subcategory – abbreviation of the document name.

For example, coding of the broad category is PD for policy documents, ID for institutional documents and OD for operational documents. The code expands in reference to sub-categories, for example, white papers, national frameworks, regulations, government gazettes and acts, as in the policy document category. A sequential number is then assigned to each document within a subcategory, followed by a description of the document. For example, PD for the category policy document, GG for the sub-category government gazette, numbers 1, 2, 3, 4 for sequence; followed by the specific government gazette number, culminating in PD-GG2-40531, for example. Where specific numbers were not available, a short descriptive abbreviation was used, for example NDP2030, referring to the National Development Plan 2030, a national framework policy document carrying the code PD-NF1-NDP2030. A vast volume of relevant documentation was found. Once a saturation point was reached, for instance, when new documents no longer yielded new information, sampling was stopped to keep Phase 1 of the study manageable. The data was compiled into data points and analytic memos detailed in Chapter 4.

Table 3.2 displays the coding for all the document categories and sub-categories. It shows the variety of documents that were analysed, with its numerical and (or) descriptive reference and provides a more comprehensive description of each document. The kinds of documents

included, and the data derived from them is discussed in the section following this tabular summary.

Table 3.2: Sourced documents, coding and description

Source: Author

Document Category and Sub-Category	Document Code	Description
Policy: Acts	PD-A1-ConSA	Policy Document – Act 1 – The Constitution of the Republic of South Africa 1996
	PD-A2-NWA	Policy Document – Act 2 – National Water Act 36 of 1998 (NWA)
	PD-A3-NEMA	Policy Document – Act 3 – National Environmental Management Act 107 of 1998 (NEMA)
Policy: White Papers	PD-WP1-White Paper	Policy Document – White Paper – National Water Policy
Policy: National Frameworks	PD-NF1-NDP2030	Policy Document – National Framework 1 – National Development Plan (NDP) 2030
	PD-NF2-NWSF	Policy Document – National Framework 2 – National Water Security Framework (NWSF)
Policy: Regulations	PD-Reg1-810	Policy Document – Regulation 1 – 810 establishment of a Water Resource Classification System
Policy: Government Gazettes (Water Resource Classes and RQOs)	PD-GG1-39943	Policy Document – Government Gazette 1 – 39943 (Olifants-Doorn, Olifants, Upper Vaal, Middle Vaal, Lower Vaal – Water Resource Classes and RQOs)
	PD-GG2-40531	Policy Document – Government Gazette 2 – 40531 (Letaba and Inkomati – Water Resource Classes and RQOs)
	PD-GG3-41306	Policy Document – Government Gazette 3 – 41306 (Mvoti to Umzimkulu – Water Resource Classes and RQOs)

Document Category and Sub-Category	Document Code	Description
	PD-GG4-42775	Policy Document – Government Gazette 4 – 42775 (Crocodile West Marico, Mokolo and Matlabas – Water Resource Classes and RQOs)
	PD-GG5-43015	Policy Document – Government Gazette 5 – 43015 (Mzimvubu – Water Resource Classes and RQOs)
	PD-GG6-43726	Policy Document – Government Gazette 6 – 43726 (Breede-Gouritz– Water Resource Classes and RQOs)
	PD-GG7-42457	Policy Document – Government Gazette 7 – 42457 (Berg – Water Resource Classes and RQOs)
Policy: Government Gazettes (Reserve Determination)	PD-GG8-41473	Policy Document – Government Gazette 8 – 41473 (Olifants-Doorn Catchments Reserve Determination)
	PD-GG9-41887	Policy Document – Government Gazette 9 – 41887 (Olifants and Letaba Catchments Reserve)
	PD-GG10-41970	Policy Document – Government Gazette 10 – 41970 (Mvoti to Umzimkulu Catchments Reserve)
	PD-GG11-42584	Policy Document – Government Gazette 11 – 42584 (Inkomati Catchment Reserve)
	PD-GG12-43734	Policy Document – Government Gazette 12 – 43734 (Vaal Water Management Area Reserve)
	PD-GG13-45568	Policy Document – Government Gazette 13 – 45568 (Crocodile West and Marico Catchments Reserve)
	PD-GG14-45735	Policy Document – Government Gazette 14 – 45735 (Mokolo and Matlabas Catchments Reserve)
Institutional: Sector Plans	ID-SP1-NW&SMP	Institutional Document – Sector Plan 2 – National Water and Sanitation Master Plan
Institutional: Sector Strategies	ID-SS1-NWRS-Ed1	Institutional Document – Sector Strategy 1 – National Water Resource Strategy (NWRS) Edition 1
	ID-SS2-NWRS-Ed2	Institutional Document – Sector Strategy 2 – National Water Resource Strategy (NWRS) Edition 2
	ID-SS2-NWRS-Ed3	Institutional Document – Sector Strategy 2 – National Water Resource Strategy (NWRS) Edition 3

Document Category and Sub-Category	Document Code	Description
	ID-SS3-IWQMS	Institutional Document – Sector Strategy 3 – Integrated Water Quality Management Strategy
Institutional: Organisational Plans	ID-OP1-DWS APP-2021/22-2023/24	Institutional Document – Organisational Plan 1 – DWS Annual Performance Plan (2021/22 - 2023/24)
	ID-OP2-DWS APP-2022/23-2024/25	Institutional Document – Organisational Plan 2 – DWS Annual Performance Plan (2022/23 - 2024/25)
	ID-OP3-DWS SP-2009-2014	Institutional Document – Organisational Plan 3 – DWS Strategic Plan (2009 -2014)
	ID-OP4-DWS RSP-2015/16-2019/20	Institutional Document – Organisational Plan 4 – DWS Revised Strategic Plan (2015/16 - 2019/20)
	ID-OP5-DWS RSP-2020/21-2024/25	Institutional Document – Organisational Plan 3 – DWS Revised Strategic Plan (2020/21 - 2024/25)
Institutional: Organisational Structure	ID-OS-2014	Institutional Document – Organisational Structure 2014
Institutional: Annual Reports	ID-AR1-DWS-AR	Institutional Document – Annual Report 1 – DWS Annual Report year
	ID-NSoW1-2019/20	Institutional Document – NSoW 1 – National State of Water Report for South Africa 2019/20
	ID-NSoW2-2021	Institutional Document – NSoW 2 – National State of Water Report for South Africa 2021
	ID-NSoW3-2023	Institutional Document – NSoW 3 – National State of Water Report for South Africa 2023
	ID-PR1-WRC-TT-838/1/20	Institutional Document – Project Report 1 – WRC TT 838/1/20
	ID-PR2-WRC-2345/1/18	Institutional Document – Project Report 2 – WRC 2345/1/18
	OD-MP1-REMP	Operational Document – Monitoring Programme 1 – River Eco-status Monitoring Programme

Document Category and Sub-Category	Document Code	Description
Operational: Monitoring Programmes	OD-MPR2-SoR1-2017/18	Operational Document – Monitoring Programme Report 2 – River Eco-status Monitoring Programme 2017/18.
Operational: Project Reports	OD-PR-IRR1-Olifants-Doorn	Operational Document – Project Report – Issues and Response Register 1 – Olifants Doorn
	OD-PR-IRR2-Vaal	Operational Document – Project Report – Issues and Response Register 2 – Vaal
	OD-PR-IRR3-Olifants	Operational Document – Project Report – Issues and Response Register 3 - Olifants
	OD-PR-IRR4-Letaba	Operational Document – Project Report – Issues and Response Register 4 - Letaba
	OD-PR-IRR5-CrocWest	Operational Document – Project Report – Issues and Response Register 5 –CrocWest
	OD-PR-IRR6-Mvoti	Operational Document – Project Report – Issues and Response Register 6 - Mvoti
	OD-PR-IRR7-Inkomati	Operational Document – Project Report – Issues and Response Register 7 - Inkomati
	OD-PR-IRR8-Mzimvubu	Operational Document – Project Report – Issues and Response Register 8 - Mzimvubu
	OD-PR-SI&CT	Operational Document – Project Report – Stakeholder involvement and communication tool analysis and standardisation Report

In Table 3.2, policy documents were the first category and included legislative documents, such as acts, regulations, government gazettes and national frameworks. Institutional documents were the second category and included sector strategies, plans, organograms and annual reports. Lastly, the operational documents included practice-related information. Selection of all documents was guided by Wach, Ward and Jacimovic (2013) in his recommendation that documents should be available in the public domain and these included project reports, programme level annual reports and stakeholder engagement records. Approximately 45 documents across all the categories were sourced and analysed.

All of these documents were relevant because they provided data and context within which the research participants operate. Secondly, they provided background information, historical insight, and was used in this study for bearing witness to past events. The information and insights were helpful for me to understand the historical roots of specific issues during Phase 1, to contextualise case study factors and to bring perspective for data collected during Phase 2, later in the study. In addition, I analysed the documents for evidence of learning. The information further provided a means of tracking change and development, where various editions of a particular document were available. I was able to compare these to identify changes, for example in the National Water Resource Strategy (NWRS) edition 1 of 2004, edition 2 from 2013 and edition 3 released in 2023 (South Africa. DWAF, 2004; DWA, 2013; DWS 2023, respectively).

Stakeholder engagement records were found in Issues and Response Registers (IRRs) used by DWS. These IRRs record questions and responses provided by the RDM project teams during stakeholder consultation meetings. Project IRRs are readily available on the DWS website for written engagement with stakeholders on RDM matters for each project and detailing how they were addressed. The IRRs provide a means for accessing the voice of stakeholders from various backgrounds, for example, local water resource managers, civil society, water users and municipal representatives. Reading through IRRs captured from historically conducted projects helped me to identify questions that have been frequently asked by stakeholders over time, which highlights the public's matters of concern in RDM processes. Moreover, as outlined in DWS (2016), the IRRs provide insight into institutional responses to issues raised and how matters raised by stakeholders were addressed. IRRs from other RDM project areas, not part of this study, for example, in the catchments and water management areas of Vaal, Mzimvubu, Mokolo, were also included to obtain a broader scope of stakeholder voices. These were used to include factors raised over time by stakeholders in different areas, for comparison and identifying areas of change, over time, for all projects conducted to date. It also assisted in bringing the history of issues and responses to the study analysis, through community voices.

This was important in this study, as stakeholder engagement is a core element of RDM projects, where project outputs are intended to be generated in consultation with interested and affected stakeholders. Exploring learning, if any, how it comes about and any contributions it may have made towards the co-development of RDM tools and its implementation is of great interest in the study, with an emphasis on social learning. The range of stakeholders among whom social learning was of interest included RDM officials, and those from other government departments and sector institutions, that share the mandate for water resource protection. The IRR documents therefore provided valuable documented information on stakeholder views, sector wide, in areas where RDM projects have been conducted.

3.4.1.6 Mirror data

Mirror data was described by Lotz-Sisitka, Mukute, Chikunda, Baloi and Pesanayi (2017) as that generated with communities during early stages of an expansive learning cycle, regarding the object of the activity, to identify history, tensions and contradictions. Although my study was not designed to engage role-players in expansive learning cycles, I believe that the sharing of Phase 1 insights during Phase 2, involved a form of mirror data.

I selected subject matter specific data from the Phase 1 analysis of policy, institutional and operational documents listed in Table 3.2 to derive information relevant to the study objectives (see Sections 1.4 & 3.3). Whilst the publication date of the documents was considered, to align with the study period, namely 2013 to 2023, older relevant documents were included due to the theoretical framework for looking into historicity. The timeline enabled the establishment of a baseline for tracking changes and progress in policy and practice over time and drawing out key insights related to organisational learning, over time. Moreover, the timeline defines the boundary and contains the scope of the study, which would otherwise be unmanageable given the depth of the qualitative analysis, and the volume of documents available for analysis.

The information and findings were used to serve as contextual background and mirror data into the interviews and in-field discussions with participants in Phase 2 of the study.

3.4.2 Engagements with role-players: study phase 2

Objective 2 of the study was *to examine the implementation experiences of role-players and identify their associated learnings derived from participation in identified RDM interventions* in the three cases. Phase 2 therefore aimed to surface the voice of role-players, their insights and learnings over the past ten years, in implementing Chapter 3 of the NWA (South Africa, 1998) through RDM. My role as a member of the community of practice was explicitly shared with all research participants, in line with Rhodes University's research ethics requirements (see Section 3.6).

3.4.2.1 Presentation of initial findings on a sector platform

To initiate engagements with role-players, findings from the document analysis were presented at the National Wetlands Indaba (NWI) conference in October 2022. The conference provided a platform for engagement with role-players in the broader case area of RDM determination. Preparing for, and delivering the presentation at this conference gave me the opportunity to package the findings and refine my interview questions. Post the presentation, various engagements ensued with interested and affected sector practitioners who shared experiences of RDM in their respective organisations. These experiences are shared in Chapter 5 and Figure 5.1. Participation in the conference provided a platform for testing the role-player engagement presentation and enabled refinement of the materials and questions in preparation for further engagements with role-players in the selected case study areas.

3.4.2.2 Semi-structured interviews

Twenty semi-structured interviews were conducted with selected water sector practitioners, largely working with RDM for water resource protection in DWS's National Office and the KZN and Mpumalanga Provincial Offices, and others in the Inkomati Usuthu Catchment Management Agency (IUCMA), the KZN Proto-CMA, and still others in the wider water ecosystems management practice. These interviews were conducted to generate data on their experiences in the respective activity systems. The section below provides details on the interview process.

(a) Study participants selection

The initial set of research participants were selected through purposive sampling also known as judgment sampling where participants that fit the parameters of the research goals were chosen (Tracy, 2013; Etikan, Musa & Alkassim, 2016). This non-random sampling approach was used to target sector practitioners working in RDM for water resource protection and wider related water ecosystems management. Guided by Etikan, Musa and Alkassim (2016), participants were chosen for the qualities they possess, such as water ecosystems management expertise across the selected case study areas (Section 3.4.2.2 [b]). As an insider researcher (see Section 1.7), I know water resource practitioners and I set out to invite them hoping they would be willing to participate in the study and share their knowledge. This initial group was selected based on their years of experience, mainly in water ecosystems management and overall water resource management, my knowledge of staff conducting RDM work, and those who agreed to participate in the study. Only one role-player declined the participation invitation citing time constraints. Thereafter, participants were sought, guided by a snowball sampling method, where role-players in the sector were identified through recommendations from the initial group of experts (Tracy, 2013).

Role-players' years of experience in practice ranged from 5 to 33 (see Table 3.3). They were selected intentionally to ensure that the sample is a pool of personnel that have experienced changes and can share historical information and learnings in the activity systems in the last five years and more. It was important to obtain role-player experiences (experienced insights) and their reflection on document analysis findings and on the overall activity systems. Role-players who were involved in the RDM projects undertaken in the study case areas were included to source individual experienced insights on case-specific factors in the activity systems. Participants were interviewed in their voluntary professional capacity to gain insights into their experiences as employees in the organisation. However, their responses to the study questions were not official institutional perspectives as official responses of the organisation would require approval by managerial staff members.

Participants did not need organisational approval to participate in the study. However, as a researcher, I had to obtain permission to conduct the study in the DWS due to resources such

as the time (such as time to conduct the interview) and premises used to avoid infringing on participants' personal spaces and time; also, for providing assurance that no foreseeable harm would befall them in participating in the study. All interviews were conducted within individual official offices and confidentiality was assured; no names or identifiable roles are used in the reporting of the findings. It should be noted however that during stakeholder events, participants spoke freely in front of others, whilst others provided information afterwards.

Study participants were found in the case studies and activity systems from within the targeted group of practitioners, as described above. At the national office of DWS, 10 knowledgeable role-players, water resource practitioners in this activity system (see Section 3.4.2.2), were interviewed (see also Table 3.3). They comprised of RDM officials, including scientists and scientific managers who take part in RDM projects as project managers and project coordinators, and directors responsible for overseeing RDM projects.

At the regional level, comprising the DWS provincial offices and Catchment Management Agency (CMA) offices, nine knowledgeable role-players, water resource practitioners in the identified activity systems, were interviewed. They included catchment managers, project managers, control environmental officers, project coordinators and other environmental management staff responsible for catchment water resource management.

During the semi-structured interviews (see Section 3.4.2.2 [d]) role-players were asked to recommend other water ecosystem management knowledgeable role-players who might participate in the study.

The coding for role-players interviewed, as in Table 3.3, was derived from the activity system (AS), for example, activity system 1, 2 or 3 and a number assigned to each role-player (RP). Second level numbering was used for the coding, to accommodate the two activity systems in case study 3, for example, AS 3.1 and 3.2, and applied to AS 1 and 2 also for consistency.

Table 3.3: Role-Players interviewed per activity system

Source: Author

Code	Designation	Years of Experience	Interview Date
Case study 1: National Office RDM determination activity system 1.1			
AS1.1-RP1	Scientist Production	11	07 February 2023
AS1.1-RP2	Scientist Production	15	07 February 2023
AS1.1-RP3	Scientist Production	15	15 February 2023
AS1.1-RP4	Scientist Production	15	10 March 2023
AS1.1-RP5	Scientific Manager	10	14 March 2023
AS1.1-RP6	Scientific Manager	33	17 March 2023
AS1.1-RP7	Scientist Production	14	28 March 2023
AS1.1-RP8	Director	22	24 and 30 March 2023
AS1.1-RP9	Director	13	03 November 2023
AS1.1-RP10	Scientific Manager	6	23 November 2023
AS1.1-RP11	DWS HR Representative	20	19 October 2023
Provincial and CMA RDM Implementation Activity Systems			
Case study 2: KZN Province RDM implementation activity system 2.1			
AS2.1-RP1	Control Environmental Officer	18	18 November 2022
AS2.1-RP2	Researcher: Community Development, Social Facilitation and Engagement Officer	5	26 May 2023
AS2.1-RP3	Water Quality Specialist	21	01 June 2023
Case study 3: Mpumalanga Province RDM implementation activity systems 3.1 and 3.2			
IUCMA RDM implementation activity system			
AS3.1-RP1	Environmental Officer Specialised Production Scientist	11	23 March 2023
AS3.1-RP2	Scientist Production and former IUCMA official	14	28 March 2023
AS3.1-RP3	Senior Manager: Resource Planning and Operations (Water Resource Engineer)	6	07 June 2023
AS3.1-RP4	Director: NGO (AWARD)	26	09 June 2023
Olifants Proto-CMA RDM implementation activity system			
AS3.2-RP1	Control Environmental Officer	14	19 June 2023
AS3.2-RP2	Catchment Manager	19	04 December 2023

(b) Description of interviewed study participants per case study

Section 3.4.2.2 (a) provides details on role-player selection. A description of role-players interviewed in each case study is as follows:

(i) Case study 1: National Office RDM determination

These research participants were role-players in the DWS National Office, who have been involved in various RDM determination projects in the last 10 years and more, including some involved in the RDM determination projects of the selected catchment case study areas.

(ii) Case study 2: KZN Province RDM implementation

Role-players interviewed in this case were water resource practitioners in the KZN provincial office. Group discussions were also held in a workshop with these provincial role-players from various institutions, involved in RDM project implementation at catchment level, in the last 10 years and more.

(iii) Case study 3: Mpumalanga Province RDM implementation

These interviewed role-players were water resource practitioners from DWS Mpumalanga Provincial Office and the Inkomati Usuthu Catchment Management Agency. They included also a role-player from a local NGO, who has been involved in various RDM project implementation at catchment level in the last 10 years and more.

(c) Invitations to participate in interviews

When participants were invited to participate in an interview, they were provided with a synopsis of the research, including the kinds of questions that would be posed (see Appendix 5). They were made aware that the information discussed could be treated as confidential, should they so wish. At the same time, I also offered to acknowledge all who contributed to the study, anonymously or otherwise. Participants were asked to formally indicate consent to participate, either in writing or on a voice recording (see Appendix 5, Annexure B). As part of obtaining consent to conduct the study, the organisation was provided with a copy of the full research proposal, inclusive of the study objectives and data generation processes.

(d) Semi-structured interviews process

I arranged in-person interviews at work premises at times suitable for participants, most often lunchtime. To initiate the interview, I shared a PowerPoint presentation to introduce the study and explain its processes, the benefits and risks for participation and what had been done and found thus far. I also shared the mirror data and findings of the document analysis process of Phase 1. Role-players were given the choice to be recorded electronically or through note taking. All in-person interviewees opted for notes to be taken. Three interviews were conducted online and these participants allowed me to record the interview on the Microsoft Teams platform.

Phase 1 findings include enablers, challenges, activity systems and contradictions, related to RDM determination and implementation were shared with role-players to solicit their views, inputs and comments, and to initiate further discussions. As key informants, the role-players had an opportunity to engage with these findings and they were invited to provide input based on their practitioner experiences. Role-players were provided with the opportunity to interact with and input information during the presentation and also thereafter, through comments on transcripts shared.

Interviews were approached as dialogic discussions with role-players, allowing for interactions, contributions and deeper probing by me, as the researcher. This promoted co-generation of information with participants while seeking substantiation in a credible manner. To this end, an open dialogue space was promoted for participants to engage freely, for them to access research data and subsequent findings, and for further engagements on thoughts and ideas that may arise post discussions. Notes were taken to record interviews with role-players, and then captured into interview transcripts. These transcripts were motivated by the data logging templates introduced by Yin (2009) adopted in this study for building a chain of evidence towards explanations, alongside Phase 1 analytic memos and analytic statements (see Chapter 4).

Interview transcripts were shared back to participants for information review, additions and corrections, and to afford them the opportunity to confirm key points, make edits and grant

permission for direct quotes to be used in the study. Thomas (2006, p. 244) explained that such “stakeholder or member checks enhance the credibility of findings by allowing participants and other people who may have specific interests in the evaluation to comment on or assess the research findings, interpretations, and conclusions”.

(e) Interview questions

The study sought to establish what role-players, individually, units or organisations, had learned in the RDM interventions implemented in the past ten years. The Phase 1 analysis surfaced contextual insights into the case study focus areas, based on historical documents. Uncertainties and information gaps were identified and compiled into questions for discussions with role-players in Phase 2. Interview questions were further informed by the study objectives and its theoretical framework for this critical realist social learning orientated organisational learning enquiry.

Given the critical realist philosophy underpinning this study, interview questions were framed to obtain evidence of claims made that cater for tangible manifestations of what actually happened, and to provide evidence-based truth in the multiple layers of reality in the activity system, through multiple data sources.

The questions were piloted with two role-players to ensure clarity and identify gaps for the interview discussions. The list of questions was open-ended, as dialogue with role-players, and the overall iterative process of sharing and discussing findings from the document analysis, was envisaged to lead to additional questions. The compilation and framing of the semi-structured interview questions was therefore informed by the study objectives, document analysis findings, and a critical realist orientation to establish the why, how information for the study organisational learning enquiry. Appendix 5, Annexure A provides the list of final questions used for role-player interviews. The section below provides more detail on the questions per section or category and how they were derived.

(i) Role-player experiences on activity system factors and contradictions

The study deployed the second generation CHAT framework to the water resource protection practice of RDM, at national and regional level. Viewed as an activity system, the intention was to offer explanatory depth on factors that relate to what role-players in RDM do, why and how, in pursuit of the water resource protection object and outcome of their activity.

CHAT application in this study resulted in mapping the activity systems, with the associated instruments/tools, subjects, rules, community, division of labour, object and outcome, in the selected RDM water resource protection case studies. It also led to surfacing tensions and contradictions within the activity systems as growth buds for learning and change. In addition, compiled activity systems provided a useful visual display of the factors per case study.

Interview questions to elicit perspectives on activity systems factors and contradictions requested that participants input, on the activity system, the tools, rules, subject, community, division of labour, object and outcomes and comment on the extent to which the contradictions resonate with their experience of the RDM activity system.

(ii) Role-player reflections on document analysis findings

Role-player reflections on known enablers and challenges for successful implementation of RDM, found through document analysis, were sought. Following the presentation to role-players of initial findings (see Section 3.4.2.2 [d]), the following interview question was posed: to what extent do the Phase 1 document analysis findings resonate with your experience of the RDM activity system? They were further requested to provide any input or comments or thoughts on the information shared.

(iii) Role-player experiences on learning

Interview questions regarding learnings during their years of experience were: has learning been happening when we look at the last 10 years? This was followed by: what has been learned by individual project managers or project teams? with one or two examples of learnings requested. They were also asked what lessons can be drawn from past resource directed measures interventions.

(iv) Role-player experiences on capacity building

An interview question regarding capacity building was what has been learned about capacity building and their views were solicited on how to produce, attract, use and retain the necessary skills for sustainable water ecosystems management through RDM. They were further asked what has been learned about up-skilling those already in the workplace and how is this learning evident.

(v) Role-player experiences on stakeholder engagement

An interview question regarding stakeholder engagement was, given that stakeholder involvement and public participation is a key aspect of RDM processes, whether in their opinion, stakeholder engagement is executed sufficiently in the process and what have been their learnings thereof over time.

(vi) Role-player views on transition from RDM determination to implementation

Interview questions regarding handover of determined RDM outputs for implementation on the ground and changes in the process included: what is the provision for handing over determined RDM for implementation on the ground, are there any processes in place for this, and if not, how is this transition currently happening? Role players were also asked to reflect on and share some of the changes that they had experienced or observed in the RDM process, in the last decade from 2013 to 2023.

(vii) Local implementation role-player experiences

For the interviews with RDM implementation role-players in case studies 2 and 3, additional questions about on the ground experiences included: what are your experiences in terms of implementing RDM, what lessons can be derived based on these experiences, what are the challenges experienced with interpretation of RDM project outcomes for incorporation into license conditions, what are the areas of disconnection between RDM determination and translation of outcomes into implementation programmes.

3.4.2.3 In-field data generation

In addition to role-players described in Sections 3.4.2.1 and 3.4.2.2, water resource protection interventions also involve practitioners across various organisations in the South African water sector, who together form a collective of specialists bounded by the common goal of sustainable water ecosystems management, for water security (see Section 2.3.2). The community of practice engaged in the current study ranges from various organisations and role-players, including:

- a) National departments, such as the Department of Forestry, Fisheries and Environment (DFFE), Department of Mineral Resources and Energy (DMRE) and Department of Agriculture, Land Reform and Rural Development (DALRRD);
- b) Parastatals and state associated institutions, for example, South African National Biodiversity Institute (SANBI), the Water Research Commission (WRC), Water Boards and the Council for Scientific and Industrial Research (CSIR) and role-players in positions of project managers, policy advisors, project coordinators, researchers and knowledge management personnel;
- c) Non-governmental organisations (NGOs) such as the World Wide Fund for Nature, South Africa (WWF-SA), Association for Water and Rural Development (AWARD), Conservation-South Africa (CSA) and the Nature Conservancy, with role-players in positions as water project managers and project coordinators;
- d) Consultants and/or environmental specialists commissioned to undertake water-related projects.

The voices of these sector stakeholders were obtained through their participation in presentations at sector platforms which included a conference (see Section 3.4.2.1), workshop and symposium, as detailed in Sections 3.4.2.3 (a) and (b) below. These sector platforms provided me with opportunities to engage with a variety of external water sector role-players (from outside of DWS) yielding valuable insights. Interactions at all three platforms were public and anonymity of opinions from participants was provided by coding (see data snippets on Figure 5.2) and inputs attributed to the group (see data Tables 5.2 and 5.3) where data came out from group discussions.

(a) Workshop

In KZN, I got an opportunity to co-host a two-day workshop with SANBI uMngeni Ecological Infrastructure Partnership (UEIP), the DWS KZN provincial office and proto-CMA (see Section 3.4.2.3 [d]) personnel for further engagement with role-players. The UEIP's interest with the study and the KZN local implementation of RDM was established at the NWI conference (see Section 3.4.1) following my presentation and stakeholder engagement process. I was given the opportunity to co-develop the workshop invitation, identify key potential participants in KZN and draft the workshop programme with the UEIP team. One of the study's key objectives, to draw lessons regarding organisational learning in the context of RDM policy implementation (see Sections 1.4 & 3.2) was included as workshop objective 1, to explore learnings that have taken place over the past ten years of RDM implementation. Chapter 5, Section 5.3 provides more detail on the workshop process and data generated. The workshop provided a platform for engagement with role-players from a variety of sector institutions in the KZN case area and obtaining their experiences with RDM.

(b) Symposium for in-field data generation

I participated in a sectoral symposium hosted by the Centre for Water and Environment at the Independent Institute of Education (IIE), commonly known as Monash South Africa (MSA) (see Figure 5.9 & 5.10). Participation in this sector platform was focused solely on the capacity building component of the study. This symposium provided me with an opportunity to engage with a variety of external water sector role-players (from outside of DWS) and to focus on capacity building as one of the major emerging themes in the study. Section 5.5 provides further detail on symposium process and data generated.

3.5 DATA ANALYSIS

3.5.1 Analytic framework for document analysis: study phase 1

Qualitative document analysis (see Section 3.4.1) entailed a systematic desktop review of the selected document texts (see Section 3.4.1.3 & 3.4.1.4) for contextual profiling and historical analysis of activity systems in the study, following an approach by Bowen (2009). As before, document analysis was employed for addressing study objective 1. During this process, I immersed myself in the data (see Appendix 14) and followed a deductive approach to processing the data and identifying information points that respond to study objective 1, identifying enabling factors and challenges relating to policy, institutional and operational factors in the context of RDM. The deductive part of the process sought data for the prior determined broad categories of enablers and challenges, in the policy, institutional and operational sub-categories within them. The process required me to read into each document and, importantly, also across documents, to compare and correlate data.

Data points (see Section 4.2) were derived in each sub-category and grouped under enablers or challenges. I then analysed these data points using analytical memos. Analytic memos are “sites of conversation with ourselves about our data” (Clarke, 2005, p. 202) and a place to offload our thoughts (Saldaña, 2013) about the ongoing research. I wrote analytic memos under each broad category of enablers and challenges and for each sub-category, policy, institutional and operational. These are discussed in more detail in Section 4.3. Writing the analytic memos facilitated a reflection process through which I could define, explain and interpret the emerging findings, guided by Tracy (2013). Document analysis culminated in analytic statements from which potential ‘growth buds for learning’ were distilled to further explore in Phase 2.

Data from the document analysis was used for the initial mapping of activity systems, applying CHAT to the identified RDM initiatives. Through this mapping I explored activity system factors, its tools, rules, subjects, community, division of labour, objects and outcomes, preliminary manifestations of contradictions, and opportunities for learning for and realising change in water ecosystems management. This analysis provided a new way of understanding

these factors and provided a useful tool for organisational learning, through sharing with role-players in Phase 2. Further detail of this activity systems analysis is provided in chapter 6.

3.5.2 Role-player engagements data analysis: study phase 2

Data of role-player experiences was analysed, guided by Miles and Huberman's (1994) suggested three broad tasks for qualitative data analysis. These include data reduction, data display, and conclusion drawing or verification. Data reduction was conducted through rigorous reading and re-reading of data transcripts. This was coupled with categorising data according to the questions discussed with role-players during the semi structured interviews (see Section 3.4.2.2). Appendix 6 and 7 show role-player inputs on Phase 1 document analysis findings that were shared with them, including inputs on activity systems, enablers and challenges. Appendix 8 to 12 shows the qualitative data grouped together per interview question, across all role-players engaged in the semi-structured interviews and in-field engagements (see Sections 3.4.2.2 & 3.4.2.3). This enabled listening to the voices and opinions of role-players, per question, and generating broad themes captured in the findings section (see Section 5.4). The third task conducted at this stage was an inductive analysis (see Section 3.5.2.2) to derive sub-categories, "thematic areas", guided by Thomas (2006, p. 245), within broad categories of each study question. Findings and recommendations were drawn as part of the overall synthesis of findings in Chapter 7.

Deductive and inductive analysis in the study were guided by Thomas (2006), Marshall (1999) and Miles and Huberman (1994). It was used to derive themes, data codes within the policy, institutional and operational broad categories, and under enablers and challenges as in objective 1 of the study. Miles and Huberman (1994, p. 56) described "a code" as "a tag or label for assigning units of meaning to the information compiled". It is a shorthand designator of letters, numbers, words, and/or phrases, that represents a theme or pattern observed in the data. I followed guidance from Boyatzis (1998) that a code should be named or labelled concisely to capture the essence of the theme and be conceptually meaningful.

3.5.2.1 Deductive approach

A theoretical, deductive, top-down approach was also used through rigorous reading and re-reading of data transcripts while categorising information according to the study questions discussed with role-players (see Section 3.4.2.2 [e]) and theoretical framings, such as questions relating to historicity as per CHAT (see Section 2.3.4) guided by Swanson and Holton (2005), this enabled the grouping of data in the broad pre-determined categories of enablers and challenges within policy, institutional and operational categories, alongside themes emerging from the inductive approach, further detailed in chapter 5.

3.5.2.2 General inductive approach

A general inductive approach was used for data analysis where data transcripts were read several times, constituting multiple reading and interpretation of the raw data (Thomas, 2006), to identify themes or categories. Systematic reading, re-reading and coding of the transcripts allowed major themes to emerge. I segmented sentences and paragraphs into categories and labelled them with descriptive phrases. This coding frame was developed for coding transcripts and updated with new themes that emerged. This process was used to develop categories, which were then conceptualised into broad themes, after further reading.

Emerging themes (or categories) were developed by studying the transcripts repeatedly and considering possible meanings and how these fitted with developing themes. Giant slide diagrams were compiled in Microsoft PowerPoint and were used to read horizontally. This involved grouping role-player insights, shared during the semi-structured interviews (see Section 3.4.2.2), into segments of text organised by discussion points, to allow the diverse views of role-players on each question, to emerge. I compared each new unit of meaning with others and, categorised, coded and grouped it with similar units of meaning. Where none existed, a new category was formed. A saturation point was reached when no new themes emerged, which suggested that major themes had been identified.

Segments of interview texts were coded, enabling an analysis of parts of the interview within a particular theme. This allowed for the documentation of relationships between themes, and the identification of those important to participants. Similarities and differences across

themes and sub-themes were also explored. In this way the themes and sub-themes emerged directly from the data. Chapter 5 captures emerging themes and sub-themes from role-player experiences.

3.5.3 Activity system analytic lens and contradiction analysis

Data analysis, using second generation CHAT (see Section 2.3.4), was conducted in two stages. Firstly, it was applied to mapping the document analysis data to the activity systems, and secondly, to formulate manifestations of contradictions. To do this, a framework was adapted from Uden (2007, p. 94-95) to guide the mapping of the activity systems and identifying contradictions within each case study, see Table 6.1, column 2. Guided by the Uden framework (ibid.), I mapped preliminary activity systems and used the framework to further shape questions related to the activity system for data generation from semi-structured interviews and sector engagements with role-players. These questions include:

- Who are the role-players in the RDM activity system in South Africa?
- What do these activity systems look like when mapped out as rules, tools, and divisions of labour?
- What are the policy, institutional and operational factors that enable or hinder RDM?
- Are there obvious contradictions that could potentially stimulate learning when reflecting on them with role-players, in subsequent phases of the study?

These mapped activity systems and summaries of possible contradictions were shared with role-players in semi-structured interviews and sector platforms (see Sections 3.4.2.2 & 3.4.2.3, respectively). These mapped activity systems proved to be a useful visual tool for starting interactions and stimulating role-player engagements. Role-player inputs (see Appendix 6) informed further refinements of activity systems.

Engeström and Sannino (2011 & 2021) provided guidance on identifying areas where contradictions might occur in activity systems. Engeström and Sannino (2011) suggested that contradictions cannot be observed directly. They can only be identified through their manifestations. They (ibid.) identified four kinds of discursive manifestations, *conflicts*, *critical conflicts*, *dilemmas* in decision making and *double binds*, doomed if you do and doomed if you

don't. They (ibid.) further provided a conceptual framework (see Table 3.4) for analysing linguistic cues that potentially express discursive manifestations of contradictions.

Table 3.4: Types of discursive manifestations of contradictions

Source: Engeström and Sannino (2011, p. 375)

Manifestation	Features	Linguistic cues
<i>Double bind</i>	Facing pressing and equally unacceptable alternatives in an activity system: Resolution: practical transformation (going beyond words)	"we", "us", "we must", "we have to", pressing rhetorical questions, expressions of helplessness "let us do that", "we will make it"
<i>Critical conflict</i>	Facing contradictory motives in social interaction, feeling violated or guilty Resolution: finding new personal sense and negotiating a new meaning	Personal, emotional, moral account's narrative structure, vivid metaphors "I now realize that [. . .]"
<i>Conflict</i>	Arguing, criticizing Resolution: finding a compromise, submitting to authority or majority	"no", "I disagree", "this is not true" "yes", "this I can accept"
<i>Dilemma</i>	Expression or exchange of incompatible evaluations Resolution: denial, reformulation	"on the one hand [. . .] on the other hand"; "yes, but" "I didn't mean that", "I actually meant"

To surface contradictions in this study, the discursive manifestations detailed in Table 3.4 were used as a route to manifestations of contradictions within interview transcript segments of the discussions. Engeström and Sannino (2011) indicated that the categorisation used in the conceptual framework is not meant to be "exhaustive" (ibid. p. 373). I therefore adopted additional manifestations to access contradictions, based on some of the data manifestations. This was guided by Jalasi (2018), and includes *tension*, *inconsistency*, *conflict of motive* and *disturbance*. This resulted in eight types of discursive manifestations for identifying contradictions, alongside the linguistic cues provided for in Table 3.4. The section below

provides descriptions of manifestations of contradictions, to help with identifying them in the activity systems analysis described in Chapter 6.

According to Engeström and Sannino (2011, p. 374), *double binds* are processes in which actors repeatedly face pressing and “equally unacceptable alternatives” in their activity with seemingly no way out. In the context of work activities, the *double bind* relates to situations in which “players are, in a way, caught in a reflexive loop”. They feel pressured to do something, but feel unable to act accordingly (Bonneau, 2013). These *double binds* are typically expressed by means of a rhetorical question indicating a ‘cul-de-sac’, a pressing need to do something, and at the same time a perceived impossibility of action (inability to act). This impossibility(inability) is commonly expressed with the help of desperate rhetorical question” (Engeström & Sannino, 2011, p. 374).

Conflict emerges out of the perpetuation of a proposal to the detriment of other alternatives (Cameron & Quinn as cited in Bonneau, 2013). “The *conflict* is expressed as a misunderstanding, a disagreement or diverging points of views and may result in resistance, refusal or rejection” (Bonneau, 2013, p. 5) or “criticism and argument” (De Dreu & Van de Vliert, as cited in Engeström & Sannino, 2011, p. 373). De Dreu and Van de Vliert (as cited in Engeström & Sannino, 2011) defined *conflict* as:

conflict occurs when an individual or group feels negatively affected by another individual or group, for example, because of a perceived divergence of interests, or because of another’s incompatible behaviour. (p. 373)

Tjosvold (as cited in Engeström & Sannino, 2011, p. 374) indicated that “people are in conflict when the actions of one person are interfering, obstructing or in some other way making another’s behaviour less effective”. According to Engeström and Sannino (2011, p. 374) “*critical conflicts* are situations in which people face inner doubts that paralyze them in front of contradictory motives unsolvable by the subject alone”. “In social interaction, critical conflicts typically involve feelings of being violated or guilty, often silenced” (Sannino, as cited in Engeström & Sannino, 2011, p. 374). To this definition, Jalasi (2018) added feelings of being

subjugated, alienated or excluded (not belonging). Engeström and Sannino (2011, p. 374) further elaborated that “the discursive working out of critical conflicts involves personal, emotionally and morally charged accounts that have narrative structure and frequently employ strong metaphors”.

Dockeray (as cited in Jalasi, 2018) described conflict of motive as a situation in which we find ourselves when two motives of approximately equal strength are opposed, getting in each other’s way and each making a claim for satisfaction at the same time.

According to Engeström and Sannino (2011), “a dilemma is an expression or exchange of incompatible evaluations, either between people or within the discourse of a single person”.

Bonneau (2013) described a *dilemma* as:

an internal conflict within the employee, who must take on two opposing roles. For example, managers at a hospital may face daily pressures due to their twofold responsibility: first of all, they must provide care to patients; secondly, they must reduce the costs associated with these services (p. 6).

Engeström (2008) defined disturbances, indicating that they are:

deviations from the normal scripted course of events in the work process, normal being defined by plans, explicit rules and instructions, or tacitly assumed traditions. A disturbance may occur between people and their instruments or between two or more people. Disturbance appears in the form of an obstacle, difficulty, failure, disagreement, or conflict (p. 24).

Engeström (2008, p. 25) further called disturbances that appear in talk “discursive disturbances”.

The definition of tension used in this study was offered by Jalasi (2018, p. 242), referring to “a state in which people disagree with, and feel anger toward each other; the state is usually

latent hostility or opposition between individuals or groups, which may result in a strained relationship between the people or groups involved”.

According to Jalasi (2018, p. 243), inconsistency refers to “self-contradictory approaches”.

The manifestations of contradictions found in the current study are discussed in chapters 6 and 7. Activity system mapping, and contradiction analysis helped me to think more deeply about the nature of the challenges that have been hounding RDM, based on the document analysis and role-player engagement data. This was further informed by a retroductive analysis, which is described next.

3.5.4 Retroductive analysis: study phase 3

Underlaboured by a critical realism orientation, CHAT provided me with a tool for in-depth analysis of the case studies to unearth deeper, underlying causal factors that may not always be visible at the surface. The combination of CHAT and critical realism was used successfully by Mukute (2010, p. 346) who found that “using CHAT and critical realism offered greater chances of achieving ontological depth”.

An intense research approach with a qualitative research design resonates with how I worked with the second generation CHAT in this study. I examined the nodes of activity systems and the interactions between each node which helped me develop an in-depth understanding of the water resource protection practice, the structures, people’s agency, and the whole system to address the research questions. As a next step, given the critical realist posture adopted, I needed a research approach that could assist me to unearth, surface and explain the causal mechanisms shaping contradictions within and between RDM activity systems. To help with this, intensive research “is strong on causal explanation and interpreting meaning in context” (Sayer, 2000, p. 21). (Sayer, 2000,) elaborated that:

Given the presence of multiple systems and causes in the things we study and the possibility of different causes producing the same effects, there is always a risk of misattributions of causality. ... There may be more than one mechanism operating in

concert of course, but this is what we have to sort out if we are to make sure we are not misattributing causal responsibility (p. 20).

To do this, in cases where researchers are concerned with discourses and the meaningful qualities of social practices, requires abstraction, followed by interpretation, and a research design which is geared to identifying such possibilities. In addition, to interpreting what actors mean “we have to relate their discourse to its referents and contexts” (Sayer, 2000, p. 20). To guide the researcher on how to abstract and interpret meaning in context within intensive approaches, and to avoid running the risk of misattributing causal responsibility, Sayer (2000) elaborated:

The intensive researchers would start at a particular point ...follow up the connections of the organ or part in question to other parts of the body, building up pictures of the body’s structure and systems.... Intensive research seeks out substantial relations of connection and situates practices within wider contexts, thereby illuminating part-whole relationships (p. 22).

Sayer (2000, p. 19) explained that “social systems are open, complex, and messy”, and therefore this requires abstraction, careful conceptualisation, and more importantly, attention to how we abstract.

Retroductive reasoning (see Figure 3.6), often used interchangeably with abduction, has been described as a process that involves the construction of hypothetical models as a way of uncovering the real structures, contexts, and mechanisms that are presumed to produce empirical phenomena (Mukumbang, Kabongo & Eastwood, 2021). As described by Sayer (2000) such an intensive research approach was “primarily concerned with what makes things happen in specific cases” (Sayer, 2000, p. 20). To be able to discover meanings, relations and consistency, to be able to obtain knowledge of social structures and transfactual conditions, abduction or retroduction is necessary (Danermark, Ekstrom, Jakobsen & Karlsson, 2002, p. 203).

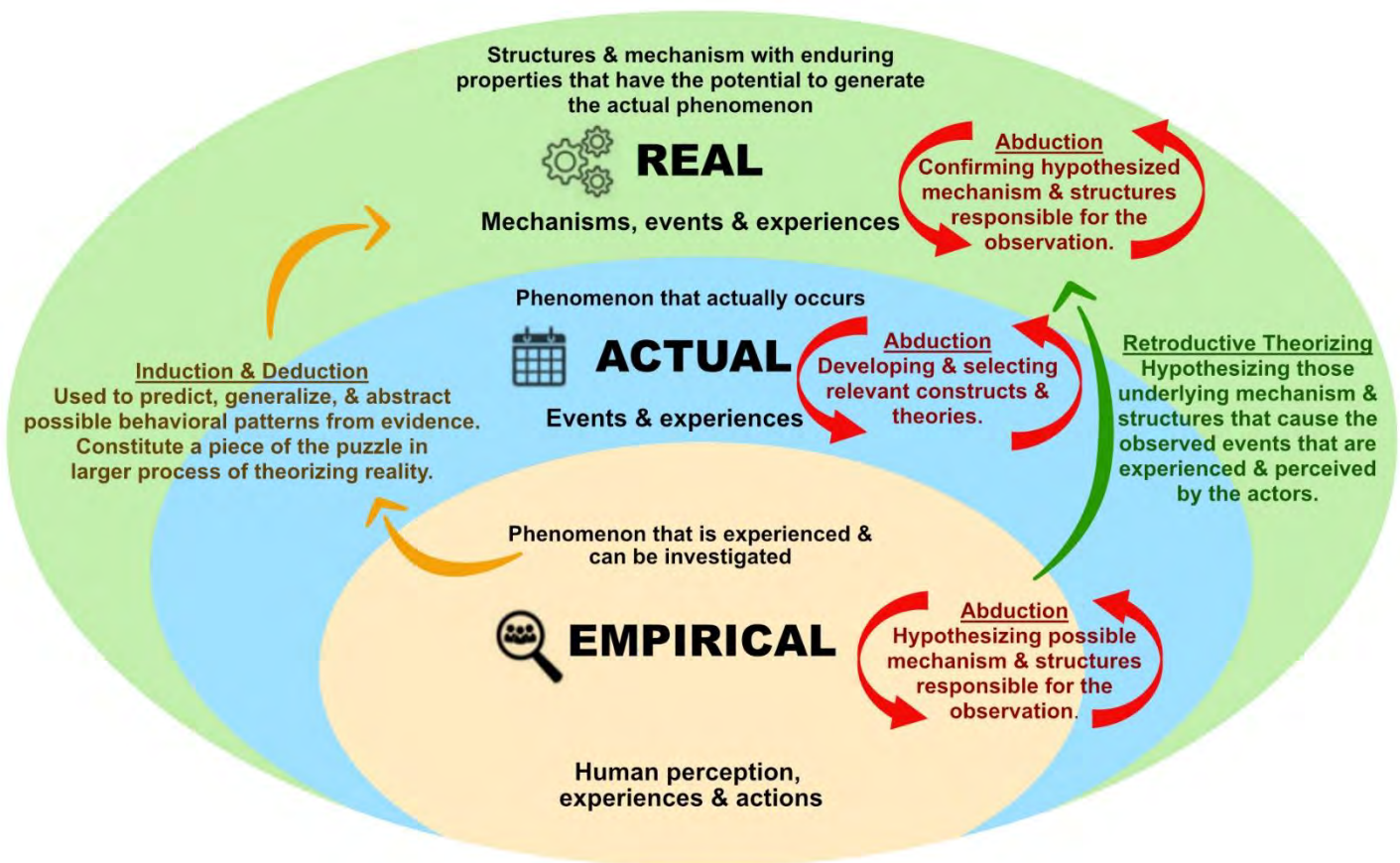


Figure 3.6: Inferencing approaches to exploring ontological depth

Source: Adapted from Mukumbang et al. (2021)

Retroductive inference in this study entailed the interpreting or explaining and recontextualising of individual phenomena within a conceptual framework where the conclusion provides new insight as an outcome of the interpretation as guided by Danermark, Ekstrom, Jakobsen and Karlsson (2002). Abduction or retroduction allows a researcher to move from a conception of something to a different, possibly more developed or deeper conception of it (ibid.). In this way, it allows the researcher to understand some data in a new way by observing and interpreting this phenomenon within a new conceptual framework.

3.6 RESEARCH ETHICS

Ethical considerations were applied in this study in line with Rhodes University ethics requirements. Permission to conduct the study was sought from the primary organisation (DWS) prior to commencement of the research (see Appendix 5, Annexure C) and Rhodes University issued ethics clearance annually for this study (see Appendix 5, Annexure D).

3.6.1 Informed consent

When participants were invited for an interview, they were given a copy of the proposal and a synopsis of the research, including the kinds of questions that would be posed. I confirmed acknowledgement of all who contributed to the study. They were asked to formally indicate their consent to participate in, and contribute to the study. The majority provided this consent in writing or in a voice recording. Permission to record all interviews was also sought. No video recordings were made. The primary organisation was given a copy of the full proposal as well as a synopsis, with details of the kinds of questions that would be posed to employees. The organisation provided full permission for conducting the study.

3.6.2 Anonymity and confidentiality

The researcher's role as a member of the community of practice was made explicit. This also meant treating information confidentially, as an insider researcher (see Section 1.7).

Role-players were given the option to choose whether they wished to remain anonymous or not. They were assured that the information would be treated confidentially and anonymously, should they so wish, and that information would be used for the academic purposes of this study only.

3.6.3 Validity, credibility and trustworthiness

Bassey (1999) defined validity as the extent to which a research fact or finding is what it is claimed to be. In critical realist research where, empirical phenomena are transcendental, influenced by time and space, the notion of transfactuality helps in validating data. This implies that the study needs to use multiple methods to generate data, critical

methodological pluralism, and use all the modes of inference, including deduction, induction, abduction and retroduction, as used in this study to make meaning of the data (Danemark et al., 2002).

3.6.4 Reflexivity as a strategy for dealing with positionality

In the current study, with the assistance of subject matter experts as critical friends, I took moments of stepping out and reflecting, every step of the way.

In upholding the ethical consideration of the study, I iteratively applied reflexivity, through questioning myself and reflecting, for awareness of my positionality as a Scientific Manager at DWS, within the case study area. This was critical as it could influence the stories I was told, how they were told to me and the narratives I formed and shared with others, influenced by my position and experiences as a researcher in relation to my study participants. My positionality as an insider was also crucial in relation to subjectivity that may lead to making assumptions, based on prior knowledge, or an inherent bias due to my close proximity to the subjects in the study.

To this end, reflexivity was employed where I remained conscious of how my position may be construed by others, or put them in a difficult position, might bias their representations, assume prior understandings or lead to an inability to raise provocative questions. I took the following measures to mitigate against these factors:

- I read and re-read role-player data transcripts and engaged them further on aspects where I needed more clarity;
- I kept a research journal reflecting on this positionality throughout the data collection stages;
- I collaborated and worked with critical friends, for reviewing all information to eliminate bias and promote reliability, including working closely with my academic supervisor through monthly study progress meetings and discussions on all aspects of the study;
- Attended annual PhD weeks and engaged with other Rhodes University Environmental Learning Research Centre (ELRC) researchers working with same methodologies; and

- Used the study theoretical framework to guide data collection and analysis.

3.6.5 Information management

With the critical realist orientation of the study, dialogic discussions with role players were facilitated through interactions and contributions from me, as the researcher, as a DWS staff member at the National Office level, in the RDM determination activity system while seeking to uncover why things are as they are. This promoted co-generation of information with participants while seeking substantiation of information in a credible manner. To this end, an open dialogue space was promoted for participants to engage freely and for them to have access to the research findings for further engagements post discussions. Data was reported and presented truthfully, and participants were afforded the opportunity to confirm key points and grant permission for direct quotes to be used in the study, and be attributed to them or not.

Information from the workshop and symposium were captured alongside role-players on charts and discussed within the group. This information was further verified from the written minutes of the event proceedings, shared by organisers after such events. With the conference information, I allowed role-players to write down their views, feedback, inputs in my research journal to ascertain accuracy.

3.7 CONCLUSION

In this chapter, I have provided the study approach and design. A case study design was selected to explore the case of RDM for water resource protection at National Office level and two provincial case studies, in KZN and Mpumalanga Provinces RDM projects. I have outlined the qualitative research data generation methodology which included document analysis and role-player engagements through semi-structured interviews, workshop, symposium and one-on-one interactions. This was followed by an outline of the study data analysis which included the analytic framework for the document analysis, in Phase 1 through analytic memos, culminating in analytic statements. Thirdly, role-player engagement analysis, from data generated through Phase 2, through deductive and inductive approaches, and activity system mapping and contradiction analysis using all the study findings were described. Lastly, retroductive analysis was described in its application to all study findings to deepen insight and derive causal mechanisms. The chapter is concluded with ethical considerations in terms of participants' consent, research validity, researcher reflexivity and information management.

4. CHAPTER FOUR: DOCUMENT ANALYSIS

4.1 INTRODUCTION

In Phase 1 of this study, Qualitative Document Analysis (QDA) guided by Altheide (1996, 2000), Bowen (2009) and Wach, Ward and Jacimovic (2013) was undertaken to address research Question 1: *What are the policy, institutional and operational enablers and challenges for water ecosystems management through Resource Directed Measures (RDM) implementation in South Africa?* The document analysis process was outlined in Section 3.4.1. This chapter provides findings of this document analysis in the form of key data points, analytic memos and statements.

4.2 KEY DATA POINTS

It is important that this chapter be understood as a presentation of findings from a data mining exercise (see raw data in Appendix 14) and not as a literature review. Hence conventions like in-text reference citations and page references for quotations are not used. Documents were coded according to the key provided in chapter 3 (see Section 3.4.1.5) and presented in the sections that follow as data artefacts.

4.2.1 Key policy data points

4.2.1.1 Key data points: policy enablers

Policy enablers identified through the study, include:

- Prioritization of water ecosystem protection is evident, ranking from the highest legal tool in the country, the Constitution of the Republic of South Africa (PD-A1-ConSA), which specifies that “everyone has the right to an environment that is not harmful to their health or wellbeing”.
- South Africa’s National Planning Commission (NPC) has developed national frameworks including the National Development Plan (NDP, PD-NF1-NDP2030) and the National Water Security Framework (NWSF, PD-NF2-NWSF) which provides priority actions for ensuring water security by 2030.

- In response to the Constitution of the Republic of South Africa, Chapter 3 of the National Water Act (PD-A2-NWA) stipulates the need for protection of water resources through the development of RDM, including the determination of Water Resource Classes, Reserve, and Resource Quality Objectives (RQOs), in the context of the National Water Resource Strategy (NWRS) and Catchment Management Strategy (CMS, PD-A2-NWA).
- The NWA (PD-A2-NWA) further specifies that the Catchment Management Agency (CMA) must seek co-operation and agreement on water-related matters from the various stakeholders and interested persons, a core element in the development of the CMS.
- The second edition of the NWRS (ID-SS2-NWRS-Ed2) outlines key principles for enabling water resource protection and Principle 2 indicates that “water resource protection should be based on a participatory approach, involving users, planners and policymakers at all levels: the participatory approach to water resource protection should involve raising awareness of the importance and value of water among policymakers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the management of our water resources”.
- Moreover, the National Environmental Management Act 107 of 1998 (PD-A3-NEMA) stipulates that “pollution and degradation of the environment are to be avoided” and where they cannot be avoided altogether, they should be “minimized and remedied”. Thus, policies relevant to the water sector are also developed ‘outside’ of the sector, in this case the broader environmental sector, suggesting the importance of collaboration.
- Provision for water resource protection has been made in water sector strategies such as the National Water Resource Strategies (ID-SS1-NWRS-Ed1, ID-SS2-NWRS-Ed2, ID-SS2-NWRS-Ed3) and action plans (such as ID-SP1-NW&SMP), led by the DWS.
- Completed RDM (Classes, Reserves and RQOs) have been published in the Government Gazettes (PD-GG1-39943, PD-GG2-40531, PD-GG3-41306, PD-GG4-42775, PD-GG5-43015 and PD-GG6-43726). Once gazetted they become legally binding, placing an obligation on all citizens to comply with these measures and to ensure that water resources are protected. Non-compliance is unlawful.
 - An initial gazette for written public comment, as part of stakeholder engagement, is first published, PD-GG4-42457. Stakeholders are invited to provide inputs/comments

over a period of 60 days. After consideration of public comments the gazette is published.

- Step-by-step guidelines have been developed in government Regulation 810 (PD-Reg1-810) with processes and procedures that should be followed for determining RDM.

4.2.1.2 Key data points: policy challenges

Challenges emerging through the document analysis, are:

- Based on Issues and Response Registers (IRRs, see Section 3.4.1.5 and Table 3.2), it is evident that stakeholders have argued that some stipulations of the NWA (PD-A2-NWA) require amendment, including:
 - Allowing re-classification of the Water Resource Class (Classes) after a stipulated period, in cases where there are new socio-economic drivers to be considered or where stricter measures need to be put in place.
 - The NWA (PD-A2-NWA) specifies the classification of 'significant' water resources. However, the meaning of significant is not defined.
- Documents like the NWSF recognise that water sector legislation and policy implementation actions in South Africa have been slow due to various challenges, including sector capacity, lack of collaboration and coordination among jointly responsible entities (PD-NF2-NWSF).
- The procedures for determination of the Classes, Reserve and RQOs (PD-Reg1-810) overlap, which means that all three of these RDM interventions should ideally be executed simultaneously through one project. Where the projects are separate, the lag time between Classification, Reserve and RQOs determinations results in inefficiencies, as some information require updates before the next project can proceed.
- A lack of provision for the review of gazetted stipulations was raised as a challenge in the Mvoti, Inkomati and Vaal IRRs (OD-PR-IRR6-Mvoti, OD-PR-IRR7-Inkomati, OD-PR-IRR2-Vaal, respectively) due to RDM resulting in water use limitations for users. However, this factor is only a challenge from the viewpoint of the water users. Water users may desire less stringent measures depending on the immediate socioeconomic needs. On the other hand, from the viewpoint of the authorities, stringent measures could be enabling for ensuring water resource protection regardless of water use changes in an area, ensuring

longer-term viability of the resource. Considering also that authorities may not have the resources for the desired 5-year review.

- Misinterpretation in the translation of RDM outputs into implementation tools and programmes have been documented in a project report of the Water Resource Commission (WRC, ID-PR1-WRC-TT 838/1/20).
- Lack of provision for a transition process to hand-over RDM outputs to implementers at the local level.

4.2.2 Key institutional data points

4.2.2.1 Key data points: institutional enablers

Institutional enablers identified through the study, include:

- RDM determination targets are reflected in the DWS business plan, meaning that resources, such as personnel, budget and time will be allocated for these processes (ID-OP1-DWS APP-2021/22-2023/24; ID-OP2-DWS APP-2022/23-2024/25).
- DWS has a Chief Directorate: Water Ecosystems Management (CD:WEM) responsible for RDM, that consists of the Water Resource Classification, Reserve and Sources Directed Studies directorates with personnel, budget and time dedicated to water ecosystems management functions for water resource protection.
- Over-time changes have been implemented to the DWS organisational structure. The latest structure came into effect in 2022. The RDM unit has been retained with minor changes over the study period of 2013 to 2023. Examples of the changes include that the RQOs unit was separate in the past and is currently integrated into Classification, and the Sources Directed Studies Directorate has been added to the RDM unit. This integration has created greater efficiency.
- It was evident from documents such as the National Water and Sanitation Master Plan (ID-SP1-NW&SMP), the National Water Resource Strategies (ID-SS1-NWRS-Ed1, ID-SS2-NWRS-Ed2, and ID-SS2-NWRS-Ed3) and the National Water Security Framework (PD-NF2-NWSF) that various institutions are involved in water resource protection in South Africa. This enables the division of labour. For example, key partnership initiatives, led by institutions with a shared water resource protection mandate, are geared towards enabling strategic water source areas protection, such as “the South African National

Biodiversity Institute (SANBI), DWS and the Council for Scientific and Industrial Research (CSIR) have identified key strategic water source areas in the country which must be protected and maintained if water security is to be achieved. The Department of Forestry, Fisheries and Environment (DFFE) and SANBI had received funding from the Global Environment Facility (GEF) for improving financial flows for restoring ecological infrastructure and for strengthening institutional capacity for this task” (ID-SP1-NW&SMP).

- Cooperative governance is enabled through data sharing among public sector institutions dealing with water resource protection, which contributes to filling data gaps. As an example, SANBI’s National Freshwater Ecosystem Priority Areas (NFEPA) identified strategic spatial priorities for conserving water ecosystems, and supporting the sustainable use of water resources, that feed into RDM by providing national freshwater priority areas in the form of maps (ID-SS2-NWRS-Ed2).

4.2.2.2 Key data points: institutional challenges

Challenges emerging through the document analysis, are:

- Although the involvement of various institutions responsible for water resource protection can be enabling, as noted above, it also becomes a challenge where efforts are fragmented and not integrated for greater impact. “The state water and sanitation sector is currently comprised of a large number of institutions with a complex suite of functions divided among them, which creates an overly complex value chain” (ID-SP1-NW&SMP).
- The cross-cutting water resource protection mandate, among government departments, can be a challenge.
 - Implementation of the NEMA (PD-A3-NEMA) is mandated to the Department of Forestry, Fisheries and Environment (DFFE). This indicates an overlap in the water resources mandate with DWS. Challenges with the misalignment of roles and responsibilities, across the two institutions, is inevitable.
- Cooperative governance is not evident among different spheres of government, for example, between municipalities and DWS for combating water quality deterioration from Waste Water Treatment Works (WWTWs) ID-SS3-IWQMS.

- There is a lack of integration of efforts among government departments. The development of the NWSF (PD-NF2-NWSF) was conducted separately from that of the NW&SMP (ID-SP1-NW&SMP) within roughly the same timeline of 2018 to 2020, with similar aims. Addressing water resource management challenges takes considerable effort that cannot be undertaken by the DWA alone. It requires integration with DFFE, and the Departments of Agriculture, Land Reform and Rural Development (DALRRD), Mineral Resources and Energy (DMRE), and Department of Human Settlements (DHS), those responsible for economic development, as well as business and civil society (ID-SS2-NWRS-Ed2).
- Classification, Reserve and RQOs in RDM determination were initially undertaken separately, leading to misalignment. Classification and RQOs units were later merged under one directorate and this status quo prevails, as an enabler. However, the Reserve unit is still separate and, where projects are not aligned, a lack of integration leads to inefficiencies. The determination of RDM “will usually be undertaken as an integrated exercise. This will be done once the resource classification system is established” (ID-SS1-NWRS-Ed1).
- Institutional capacity challenges include:
 - Limited financial resources to undertake the work, nationwide, for all catchments. “Given the state of the world economy, it is likely that funding will be constrained for some time and, accordingly, it will be necessary to stretch the financial resources by prioritising investments, optimising available financial resources” (ID-SS2-NWRS-Ed2).
 - Multi-expert teams are required to undertake each project. The compilation of teams internally within DWS, would span across chief directorates, creating coordination, coupled with a skills shortage challenge. In addition, capacity challenges have been reported in terms of number of staff and expertise available to undertake water resource management work, sector wide reported in PD-NF2-NWSF, ID-SS2-NWRS-Ed2 and ID-SS3-IWQMS. RDM projects are therefore outsourced and have been undertaken by various professional service providers over the years, resulting in different applications to determine Classes, Reserve and RQOs. “Experts from several fields of study (such as fish biology, entomology, botany, geomorphology and chemistry) are required to monitor aquatic ecosystems, in a holistic way. Few, if any,

organisations employ people covering this full suite of expertise. Therefore, to sustainably monitor the health of water ecosystems, cooperation and commitment across national, provincial and local organisations/agencies, with water management mandates, will be necessary” (ID-SS2-NWRS-Ed2).

- Challenges associated with the separation of line functions, are:
 - RDM outputs are implemented by DWS provincial offices and CMAs, separate from the CD:WEM that leads to interpretation and implementation challenges related to RDM outcomes. In an effort to implement its institutional reform and realignment, DWS undertook a rigorous exercise to separate its functions from those of the CMAs. DWS provincial offices have been incubating proto-CMAs, in anticipation of the establishment to fully fledged CMAs. ID-OP4-DWS RSP-2015/16-2019/20 detailed that the establishment of these fully fledged CMAs will see a reduction in budget and staff allocations over the next three to five years, as functions and staff are transferred to the independent CMAs.
 - Enforcement is undertaken in different units in DWS through regulatory mechanisms, such as water user licences (WUL) and authorisations. The interpretation and stipulation of RDM outcomes, in these WUL conditions, remain contested by users (ID-PR1-WRC-TT 838/1/20).

4.2.3 Key operational data points

4.2.3.1 Key data points: operational enablers

Operational enablers were identified at RDM determination and implementation, discussed separately below.

(a) RDM determination operational enablers

At the DWS National Office operational enablers for RDM determination projects include:

- To date, the RDM determination process has been completed in several Water Management Areas (WMAs) and catchments (see Section 1.6, Table 1.3 & Figure 1.8) in the country, as follows:
 - Classification and RQO projects date back 12 years to the Olifants, Olifants-Doorn and Vaal RDM projects; inceptioned in 2011, these projects were undertaken concurrently. Areas with gazetted Classes and RQOs include Olifants Doorn, Olifants, Vaal, Inkomati,

Letaba, Crocodile (West) Marico, Mokolo and Matlabas, Mvoti to Umzimkulu, Breede-Gouritz, Mzimvubu, Berg and uThukela (ID-NSoW1-2019/20). However, due to WMA re-demarcations, in some cases certain catchments might not have been included and some of these WMAs have been re-named. RDM projects currently underway in other catchments include Luvuvhu, Usutu to uMhlathuze and Fish to Tsitsikama (ID-NSoW3-2023).

- The determination of the Classes, Reserve, and RQOs “will usually be undertaken as an integrated exercise. This will be done once the resource classification system is established” (ID-SS1-NWRS-Ed1). The initial intentions were for RDM to be conducted through an integrated approach. However, Reserve projects have been conducted for over two decades and have been prioritised due to the pressing need for Reserve determinations to process applications for water use licenses. “Until the classification system is established, all determinations are "preliminary" in terms of the Act. Because water use authorisations may be considered before the Class and the Reserve have been determined for the resource in question, the appropriate procedures will be applied on an *ad hoc* basis when required for individual and *ad hoc* applications for water use” (ID-SS1-NWRS-Ed1).
- Data is a pre-requisite for RDM studies, and has been enabled through:
 - The Resource Quality Information Services’ (RQIS) National Aquatic Ecosystem Health Monitoring Programme (NAEHMP) includes the River Eco-status Monitoring Programme (REMP) which is the primary data source for water resource ecology. The REMP focuses on the monitoring of ecological conditions in river ecosystems, reflected by the system drivers and biological responses, instream and in riparian zones (OD-MPR2-SoR1-2017/18).
 - DWS information systems are in place for data management. These include those for Water Management System (WMS), Electronic Water Use License Application and Authorisation System (e-WULAAS) and National Integrated Water Information System (NIWIS) which are also available to the public for water monitoring data, license applications and general public reporting.

(b) RDM implementation operational enablers

Implementation of RDM projects takes place at the provincial level. Enablers identified at this level include:

- Information sharing among institutions is often leveraged to fill data gaps (ID-SS2-NWRS-Ed2).
- Where there is a CMA in place, stakeholder involvement and implementation are more robust, focused and efficient, for example, the Inkomati-Usuthu CMA participation in the Inkomati RDM project.
- The establishment of a functional CMAs would be core to community involvement and overall execution of water management functions at a local (catchment) level. “The role of CMAs is to ensure that water resources are managed in accordance with national policies, guidelines and standards in their jurisdiction, through the active participation of local communities and other stakeholders in the water resources” (ID-SS2-NWRS-Ed2).
- Involvement of NGOs is helpful for raising local issues at the technical level of RDM projects.

4.2.3.2 Key data points: operational challenges

(a) RDM determination operational challenges

- To determine RDM, input data is required. Data gaps are a challenge, impacting negatively on the level of RDM (desktop, intermediate, rapid) that can be undertaken, resulting in low confidence outcomes where data is limited.
- As an example, data gaps in monitoring programmes (such as the REMP) pose a challenge (OD-MPR2-SoR1-2017/18).
- As before, RDM projects have been outsourced and undertaken by various consultant teams over the years, resulting in different application of the procedures for determination of classes and RQOs (PD-NF2-NWSF, ID-SS2-NWRS-Ed2 and ID-SS3-IWQMS).
- Budget constrains together with WMA demarcation revisions have led to the exclusion of catchments in some projects.
- As before, no provision is made for the review of gazetted outcomes (OD-PR-IRR6-Mvoti, OD-PR-IRR7-Inkomati, OD-PR-IRR2-Vaal).

(b) RDM implementation operational challenges

- “While the policies and programmes for water resource protection have been endorsed and adopted, the difficulty remains in how to implement them in a cost effective and sustainable manner within a reasonable time. Therefore, much still needs to be done in the areas of implementation of water resource protection programmes and monitoring of ecosystem health to proactively minimise degradation of the resource” (ID-SS2-NWRS-Ed2).
- Implementation of RDM outputs is undertaken by different units in DWS through regulatory mechanisms, such as RDM consideration in water use license conditions. A case study on linking RQOs and site-specific conditions found that interpretations and stipulations of RDM outcomes, incorporated in these license conditions, remain contested by water users due to misinterpretations (ID-PR1-WRC-TT 838/1/20).
- RDM determination and implementation is executed at two levels, at National Office and regional (provincial office and CMA) level.
- There is a disconnection between RDM determination and the translation of its outcomes into implementation programmes.
- Implementation of ecological and user requirements by provincial offices through various regulation programmes, such as Source Directed Controls (SDCs), water use authorisations and pollution prevention measures requires resources (personnel, budgets). In the absence of functional CMAs, implementation is challenging due to capacity constraints, whereby limited provincial office staff members are also fulfilling CMA functions as proto-CMAs.
- WMA re-demarcation has been revised from 19 WMAs (ID-SS1-NWRS-Ed1) in the past to 9 WMAs (ID-SS2-NWRS-Ed2) and currently 6 WMAs (ID-SS2-NWRS-Ed3), leading to the exclusion of some catchments in certain projects.
- Local water use challenges cannot be resolved through RDM studies, and require local institutions, such as Catchment Management Forums (CMF) and CMAs to provide the platforms for addressing these challenges.
- WWTWs impact water resources, and require cooperation between DWS and local municipalities through the South African Local Government Association (SALGA).

4.2.4 Findings: enablers and challenges

The findings that emerge from Phase 1 of this study, through a comprehensive document analysis, were enablers of, and challenges in the process of determining and implementing RDM. These are summarised in Table 4.1 according to the context or level (policy, institutional or operational) at which they are being experienced. Summarising them in this tabular form allows for cross-comparison of data points.

Table 4.1: Summary of RDM determination and implementation enablers and challenges

Category	Enablers	Challenges
Policy and Legislative	1. Prioritisation of water ecosystem protection is evident and specifications are included in key South African legislative documents, such as: • the Constitution of the Republic of South Africa, 1996; • the NDP and NWSF; • Chapter 3 of the NWA 36 of 1998; • NEMA 107 of 1998; • Regulations 810. 2. Provision for water resource protection has consistently been made in key DWS policy, strategy and action plans, such as NWRS 1, 2, 3 and NW&SMP.	1. Lack of water legislation review and update. 2. Slow water sector implementation of policy commitments: • to date there are only two functional CMAs in place, impacting negatively on local water resource management, including RDM implementation. 3. Reg. 810 procedures, and step-by-step RDM guidelines, are applied differently across projects leading to a lack of standardisation, negatively affecting the interpretation of RDM outcomes. 4. This also results in inefficiency where Reg. 810 procedures were not integrated into older projects. 5. There is a disconnect in the translation of policies, strategies and RDM outputs into implementation tools and programmes.
Institutional	1. DWS has a Water Ecosystems Management Chief Directorate comprised of Water Resource Classification, Reserve	1. The complex institutional landscape reflects multiple institutions responsible for various aspects of water resource management including, water resource protection. For example, the cross-cutting water resource

Category	Enablers	Challenges
	Determination and Sources Directed Studies Directorates. - enabling the RDM water ecosystems management functions to be carried out. - Retained over-time albeit changes implemented to the DWS organisational Structure. 2. The cross-cutting water resource protection mandate, that-overlaps between DWS and other institutions, such as DFFE, SANBI, among others, on water ecosystems management, providing opportunity for cooperative governance and data sharing among public sector institutions to fill data gaps.	protection mandate, overlapping between DWS and other institutions, such as DFFE, SANBI, on water ecosystems management resulting in misalignment of areas of responsibility. - The slow establishment of CMAs. - The institutional structure for RDM, separation of Directorates responsible for Classification, Reserve and RQOs resulting in RDM projects being undertaken separately, and leading to misalignment and the lagging of information and project areas in terms of nationwide determination. - Institutional capacity challenges are evident in the limited number of staff members and budgets for undertaking the work to cover project areas nationwide for all catchments. - In addition to the previous point, multidisciplinary teams are required to undertake each project and the team compilation internal to DWS would span across chief directorates, creating coordination challenges with limited skills capacity. As a result, RDM projects were outsourced and undertaken by various professional service providers over the years, resulting in different applications of the procedures for the determination of Classes and RQOs. - The separation of line functions results in: - RDM outputs being implemented by provincial offices of DWS, separate from the Water Ecosystem Management Chief Directorate that determines RDM and leads

Category	Enablers	Challenges
		to different interpretations and implementation processes. - the majority of implementation officials on the ground (provincial, proto/CMA) not understanding how RDM should be implemented. - enforcement being undertaken by different units in DWS through regulatory mechanisms, such as water use license conditions, in which the interpretation and stipulation of RDM outcomes remain contested by users.
Operational	- Classification and RQO projects date back 12 years and Reserve projects even longer due to the pressing requirements for the latter to guide water quantity and quality allocation during the WULA process. - DWS information systems in place for data management through WMS. - Where there is a CMA in place, stakeholder involvement and implementation are more robust, focused and efficient. Therefore, a functional CMA is core to RDM implementation, community involvement and overall local water resource management. - DWS monitoring programmes such as the RQIS: (REMP) focus	- Technical work components outsourced due to water resource management capacity challenges. - Lack of funding impacts (as an example, inability to cover whole WMA for some studies). - Changes in WMA demarcations have led to exclusion of some catchments in some studies. - Technical complexity of RDM hindering local knowledge of outputs in local institutions (such as CMFs within CMAs). - Municipal challenges: WWTWs impacting on water resources - cooperative governance needed between DWS and municipalities. - RDM projects require input data, data gaps are a challenge that impacts negatively on the level of RDM projects that can be undertaken, resulting in low confidence outcomes. - RDM Determination and Implementation executed at two levels, national office and regional level (provincial and CMAs), affecting the interpretation of RDM project outcomes for incorporation into license conditions.

Category	Enablers	Challenges
	on ecological conditions in river ecosystems. Continuous monitoring through monitoring programmes such as REMP is critical to provide data for informed decision making. 5. The involvement of NGOs is helpful for raising local issues at the technical level of RDM projects. 6. The implementation of RDM outputs at regional level through regulation programmes, such as water use authorisations, water allocation measures, SDCs/pollution prevention measures enable local water resource management.	8. Disconnection between RDM determination and translation of outcomes into implementation programmes. 9. Thus far, there are only two functional CMA in place, impacting RDM implementation, provincial offices act as Proto-CMAs. 10. Although provincial offices take over the functions, in the absence of CMAs, the majority face capacity challenges (human resources and financial).

4.3 ANALYTIC MEMOS

In the next section, the findings summarised in Table 4.1 are unpacked in the form of analytic memorandums, or memos for short (see Section 3.5.1), to provide explanations of emerging insights in each category of enablers and challenges, and sub-categories of policy, institutional and operational contexts, informing objective 1 of the study.

4.3.1 Policy enablers

There is comprehensive policy and legislative provisions in the form of acts, regulations, gazettes and frameworks in South Africa to ensure that water resources are governed and protected for healthy and functional water ecosystems. In addition, water sector plans and strategies contain dedicated sections and chapters focused on water resource protection. Moreover, the DWS organisational plans, such as annual performance plans contain a dedicated line function, implying the provision of human resources, budget and time for water ecosystem management.

Provision for water resource protection has been made in key sector strategies and action plans, such as the NWRS and the NW&SMP, led by the DWS. In second edition of the NWRS (ID-SS2-NWRS-Ed2), released nine years after its precursor, NWRS 1 (ID-SS1-NWRS-Ed1), the need for water resource protection remained a high priority in the water sector's key strategic goals. This status quo prevails in the third iteration on the NWRS 3 (ID-SS2-NWRS-Ed3) published in 2023. DWS has a key role to play in leading the coordination, implementation and monitoring of these sector strategies and plans.

These provisions do not hinder the usage of water resources. However, NEMA (PD-A3-NEMA) stipulates a caution, that "development must be socially, environmentally and economically sustainable". This promotes sustainable development and aligns with further sustainable development factors of NEMA (PD-A3-NEMA), including that "the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimized and remedied".

Chapter 3 of the NWA (PD-A2-NWA) is dedicated to the protection of water resources through RDM, including Classes, Reserve and RQOs. It further stipulates that these RDM tools are to be developed within the context of the NWRS and CMS, of which the core element, in the development of the CMS, is to seek co-operation and agreement on water-related matters from various stakeholders and interested persons. Furthermore, the NWRS (ID-SS2-NWRS-Ed2) outlines key principles for enabling water resource protection and Principle 2 indicates that:

Water resource protection should be based on a participatory approach, involving users, planners and policymakers at all levels: the participatory approach to water resource protection should involve raising awareness of the importance and value of water among policymakers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the management of our water resources.

Therefore, according to the NWA (PD-A2-NWA), stakeholder engagement is central to the development of RDM tools and their implementation on the ground.

Step-by-step guidelines for processes and procedures for putting RDM in place have been produced. To date, RDM project outputs, including Classes, Reserves and RQOs have been published in several government gazettes, (see Appendix 2). Some of these gazettes contain project outputs for more than one RDM project. Government Gazette 1 (PD-GG1-39943) contains outputs for the Olifants-Doorn, Olifants, Upper Vaal, Middle Vaal and Lower Vaal Water Management Areas (WMAs), published in 2016, while Government Gazette 2 (PD-GG2-40531) contains project outputs for Letaba and Inkomati WMAs. The publishing of more than one project in a gazette is due to the period lapse between the project completion and the gazetting process, and where a number of projects have been completed and are awaiting gazetting, they were published together. It should also be noted, that WMA demarcations changed over time and some catchments may not have been included at a time of project completion, due to the use of the WMA demarcation as it was during the project undertaking.

In South Africa, a government gazette is a legal publication. So all RDM project outputs published in it are legally binding, placing an obligation on all citizens to comply with these stipulations and ensure that water resources are protected, making non-compliance unlawful. To ensure legal compliance, RDM projects must involve extensive stakeholder engagement (PD-A2-NWA). In addition, before a gazette is published, a 60-day comment period of the study outcomes is published to invite written public comments (PD-GG4-42457).

4.3.2 Policy challenges

Water sector legislation and implementation actions in South Africa have been slow (see Appendix 13) due to various challenges, including sector capacity, and a lack of collaboration and coordination among jointly responsible entities (PD-NF2-NWSF). The time-lag for initiatives to be put in place is evidently (Appendix 13) too long, hindering implementation and progress. An example is the time it takes for CMAs to be established. To date there are only two functional CMAs in the country since the requirement was stipulated in 1998 in the NWA (PD-A2-NWA). This presents a significant challenge for the implementation of water protection on the ground. In the absence of CMAs, capacity-stretched provincial offices play a dual role and stand-in as proto-CMAs.

Some stipulations in the NWA (PD-A2-NWA) require review and updates. For example, the act specifies the classification of 'significant' water resources. However, the meaning of significant is not defined. In addition, the lack of provision for review and update of gazetted RDM outcomes (PD-GG1-39943, PD-GG2-40531, PD-GG3-41306, PD-GG4-42457, PD-GG4-42775, PD-GG5-43015, PD-GG6-43726) is raised as a challenge in the Mvoti, Inkomati and Vaal IRRs, among others, due to RDM outcomes resulting in water use limitations for users. This is a challenge in that water users may later need less stringent measures, depending on changing socio-economic needs. This is then not enabled in the absence of review and updating processes for RDM outcomes. However, for authorities, this could be enabling considering that authorities might not have access to financial resources for the desired 5-year review.

The documents analysed surfaced a disconnect in the translation of policies, strategies and RDM outputs into implementation tools and programmes.

4.3.3 Institutional enablers

The institutional provision of a dedicated RDM Chief Directorate, called Water Ecosystems Management, in DWS enables water resources protection functions to be carried out through the setting of the Class, Reserve, and RQOs. The recognised importance of this function is evident in that, whilst changes have been made to the DWS organisational structure over the study period, the RDM unit has been retained with structural improvement. Notably, the RQOs unit used to be separate, and is now integrated with Classification and the Sources Directed Studies Directorate has been added. These changes have been enabling, where integrated processes can be run more efficiently. For example, in Classification and RQOs RDM components being undertaken simultaneously. This is evidence of change over time and could be an indication of organisational learning.

Various institutions are involved in water resource protection in the South African water sector (see Appendix 4 & Figure 2.3). Based on the documents analysed, these multiple entities are enabling in the more efficient division of labour and cooperative governance. For example, in data sharing among public sector institutions dealing with water resource protection to fill data gaps. It, however, also becomes a challenge where efforts are fragmented and not integrated for greater impact. This was evidenced in documents where the mandate for water resources, such as wetlands and estuaries, is shared between DWS and DFFE and has proved challenging.

The policy and legislative documents make it clear that the process of classification is intended to be consultative, a “consensus seeking process”. It requires inputs from other national, provincial and local government entities, as well as from interested and affected local and national agencies, such as CMFs, Water User Associations (WUA), and national representative bodies. In terms of RDM projects, DWS undertakes this consultation through the provincial office, CMAs or proto-CMAs catchment forums in WMA where these are in place, and which function as the locus for the consultation process. Water ecosystem

protection thus requires collaborative management by several key units both internally within the DWS, and externally. This enables Integrated Water Resource Management (IWRM). Figure 1.7 outlines the inter-relationships of key role-players in IWRM, confirmed as the intended modus operandi by the documents analysed.

4.3.4 Institutional challenges

As in the current organisational structure, implementation of RDM outputs is the responsibility of DWS provincial offices and the CMAs. Institutional challenges evident in and across documents analysed include the lack of CMA capacity in most WMAs, where they are not yet established and insufficient understanding of RDM project outputs for implementation. In addition, RDM projects have been outsourced and undertaken by various consultant teams over the years due to internal capacity challenges in DWS such as skill shortages (see below), resulting in different applications of procedures for the determination of Classes and RQOs.

It was evident from the documents analysed that cooperative governance is not strongly evident among different spheres of government, reflected in the following examples:

- water quality impacts from WWTWs.
- a lack of integration of efforts among government departments, evident in for example, the NWSF and NW&SMP processes were conducted separately, at roughly the same time.
- cross-cutting water resource protection mandates among government departments, result in the misalignment of areas of responsibility for certain water resources, specifically estuaries and wetlands.

Aligned to capacity challenges reported in water resource management (PD-NF2-NWSF, ID-SS2-NWRS-Ed2 and ID-SS3-IWQMS), there is a limited number of staff members and expertise available within for RDM to cover project areas across all catchments in the country. In addition, multi-expert teams are needed for each RDM project and team compilation, internally in DWS, would span across chief directorates, resulting in coordination, and potential skills shortage challenges. This has led to RDM projects being outsourced to various external professional service providers over the years, resulting in a variety of other

challenges, including inconsistent application of the procedures for determination of Classes and RQOs.

Policy documents are unequivocal about stakeholder engagement and public participation in RDM determination projects. The requirements include co-operation and agreement with stakeholders during the RDM steps, and on the ultimate outcomes. Local (CMA and provincial offices) platforms are the requisite stakeholder platforms through which projects can engage with stakeholders. A CMS includes objectives to aid the communication with, and participation of stakeholders. In the absence of a CMA, a CMS will, however, not be put in place for the catchment. Stakeholder engagement will therefore be limited to the Catchment Management Forum efforts of the capacity limited provincial office, as detailed in IRRs analysed.

4.3.5 Operational enablers

The outcomes of the document analysis summarised in Table 4.1 shows that a clear distinction can be drawn between operational enablers at the DWS RDM determination level at head office, and RDM implementation at the regional level.

RDM determination and the ultimate gazetting of the projects is the initial step towards water resource protection, and ultimately sustainable water resource management. Numerous Reserve determination projects have been completed to date, across all the WMAs, as a pre-requisite for the water use license application process. Several Classification and RQO projects have been gazetted. These projects make use of existing data and avoid duplication of efforts with other institutions, doing similar work. Within DWS, this ecological data is mainly obtained from the REMP. RDM determination processes are technically complex. This was evident from the issues raised in the IRRs analysed, which also suggest that the involvement of NGOs is helpful for raising local issues at the technical level of the project.

RDM implementation takes place at the regional level. Where there is a functioning CMA, RDM implementation and stakeholder involvement are more robust, focused and efficient.

DWS provincial offices act as proto-CMAs, in the absence of a CMA, conducting catchment water resource management functions and engage with stakeholders through CMF.

4.3.6 Operational challenges

RDM determination projects require input data, and several documents showed that data gaps impact negatively on the level (depth of analysis) of RDM projects that can be undertaken, resulting in low confidence outcomes. As noted in Section 4.3.4 above in relation to institutional challenges, the outsourcing of RDM projects results in inconsistent applications and procedures. Due to both the technical nature of RDM projects and internal capacity challenges, projects have been outsourced and undertaken by various external Professional Service Providers (consultant teams) over the years resulting in inconsistent application of the procedures for determination of RDM. Financial capacity challenges have also led to the inadequacy in the level of projects undertaken in some WMAs, and the inability to commission projects in some instances. In addition, changes in WMA demarcations have also led to exclusion of some catchments.

The document analysis, as a whole, points to the major operational challenge in RDM processes being implementation of its outputs at catchment level. A contributing factor is the interpretation and stipulation of RDM outputs in WUL conditions, which are often contested by users (ID-PR1-WRC-TT-838/1/20). This filters down into a disconnect in the translation of RDM outcomes into implementation programmes.

In the absence of a CMA, implementation is challenging due to DWS provincial offices' capacity constraints. According to the IRRs, RDM officials were of the view that local water use challenges cannot be resolved through RDM determination projects, and that local institutional provisions, such as CMFs and CMAs, are the designated platforms for addressing these.

The IRRs, as well as the annual reports analysed, show that major water ecosystem health challenges include wastewater treatment effluent discharges, managed by municipalities,

and impacting on water resources. The long-term history of this challenge is evidence of a need for cooperative governance between DWS and local municipal authorities.

4.4 FINDINGS: ANALYTIC STATEMENTS

Following the key data points and analytic memos presented in the previous section, the following integrated, broad statements for policy, institutional and operational contexts are evident:

1. Although there is comprehensive policy and legislative provision for water ecosystems management in South Africa, in the form of acts, regulations, gazettes and frameworks, policy implementation has been slow.
2. In the absence of functional CMAs for most catchments, implementation of functions at local level is compromised.
3. RDM determination occurs at DWS National Office, where a dedicated unit has been consistently in place for conducting this work. However, much of the work is outsourced, due to skills and capacity constraints. Furthermore, RDM implementation was intended to occur at catchment level, through provincial offices and CMAs, to decentralise institutional roles and responsibilities on water resource protection. Document analysis found that this would be enabling for localised water resource management, but a challenge due to misinterpretation of RDM outputs.
4. RDM determination projects require input data, data gaps, due to challenges in monitoring programs, impact negatively on the level of RDM projects that can be undertaken, and the confidence level of project outcomes.
5. Capacity challenges in the execution of RDM projects relate to three intertwined challenges, namely skills shortages, institutional capacity and budget constraints.
6. Some changes over time in the execution of RDM determination studies are evident through integration of Regulation 810 steps and new projects where Classes, Reserve and RQOs are determined simultaneously. Whether this is evidence of social learning taking place in the organisation, will be explored further in Phase 2.

7. Although government gazettes provide legally binding tools for ensuring adherence to RDM outputs, the lack of a review or revision provides no means for effecting amendments.
8. Cooperative management of water resources is key for information sharing, pollution prevention and effective management among the various institutions responsible for water resource protection. Efforts ought to be integrated among these various entities to ensure greater efficiency. Though legislation and various partner initiatives provide for integration of efforts, there is documented evidence that this is not taking place optimally. In phase 2 it will be important to explore whether cooperative governance is evident or not, in water ecosystems management.
9. Stakeholder engagement is a pre-requisite and core part of RDM projects and integrated water resource management. CMAs and DWS's provincial offices need to work through CMFs to engage local community stakeholders. In Phase 2 it would be important to explore the experience of role players in this regard.

4.5 CONCLUSION

This chapter provided the data points that were generated from selected document data extracts and consolidated into findings on enablers and challenges in response to research Question 1: *What are the policy, institutional and operational enablers and challenges for water ecosystems management through RDM implementation in South Africa?* Analytic memos were used to analyse data, and this culminated in analytic statements presented in Section 4.4 as one of the key findings of the study. Additionally, the document analysis findings presented in this chapter were used to compile additional questions for semi-structured interviews and served as mirror data for engagements with role-players during Phase 2, the findings of which are described next.

5. CHAPTER FIVE: ROLE-PLAYER EXPERIENCES

5.1 INTRODUCTION

In the study Phase 2, the objective was to examine the implementation experiences of personnel in Resource Directed Measures (RDM) determination and implementation (*role-players*), and identify learnings derived from their participation in the selected RDM projects in the National Office and KwaZulu-Natal (KZN) and Mpumalanga case studies. This chapter therefore addresses research Question 2: *What learning is evident from the experiences of role-players in the implementation of water ecosystem management through RDM?* In the activity system model of second generation Cultural Historical Activity Theory (CHAT, Leont'ev, 1978; Engeström, 1987; Daniels, 2008; Engeström & Sannino, 2010), *subjects* in the activity systems, role-players in RDM, as above, refer to the “individual or subgroup whose position and point of view are chosen as the perspective of the analysis” (Engeström and Sannino, 2021, p. 8). Therefore, engagements with these role-players were key.

In Phase 2, data on enablers and challenges in policy, institutional and operational contexts, generated through Phase 1 document analysis, was shared with role-players. This was shared as mirror data (see Section 3.4.1.6) through a presentation at a conference, workshop, and symposium, as well as during semi-structured interviews (see Section 3.4.2), to solicit inputs and reflect on lessons, knowledge and experiences. Through sharing their lived experiences, role-players confirmed, concretised, enhanced, added to and clarified data emerging from document analysis (see Appendix 6 & 7).

The section below provides data generated and analysed from engagements with role-players. I analysed the data within individual segments of the interview transcripts, based on the specific questions asked during the semi-structured interviews (see Section 3.4.2.2 [e]). I then grouped data points across all the interview transcripts, to identify common views and perspectives across role-players in the three case studies. I complemented this analysis with group perspectives from the workshop and symposium (see Section 3.4.2.3).

Role-players were enthusiastic to share their experiences. I had vibrant engagements with them at the 2022 National Wetlands Indaba (NWI) conference, a workshop in KZN and at the Independent Institute of Education, Monash South Africa (IIE MSA) symposium (see Sections 3.4.2.1, 3.4.2.3 [a] & [b]). Although many of the role-players were extremely busy and it was hard to obtain their availability for interviews, they were responsive and keen to find a suitable time for these engagements.

Role-player experiences presented in the next sections are structured chronologically, in the order that the engagements occurred, because role-player areas of interest, concern and curiosity were used to compile additional questions for the semi-structured interviews (see Section 3.4.2.2). These interviews yielded rich, detailed feedback and insights based on role-players' experiences.

This data was analysed using inductive and deductive approaches, yielding data themes, for example, the standardisation of RDM inputs, dissemination of RDM outputs, implementation roles, responsibilities and actions, functional technical tools, data challenges and capacity for implementing RDM, among others, presented in Section 5.4. Direct quotations from role-players are captured in italics, and my explanatory text, to make the quotations clearer, are in square brackets.

5.2 ROLE-PLAYER ENGAGEMENT AT THE NATIONAL WETLAND INDABA CONFERENCE

As before, in October 2022, I presented the Phase 1 findings at the NWI conference, at the Golden Gate Highlands National Park (see Figure 5.1). I participated in this conference to engage with role-players in the broader case area, the RDM value chain, and in preparation for further interactions in the selected case studies. This four-day event was an opportunity for me to engage role-players on a one-to-one basis in between sessions and following my presentation. These interactions enabled the refinement of materials and questions being prepared for further role-player engagement in planned semi-structured interviews. At the same time, it also surfaced relevant insights in relation to Objective 2 of the study (see Figure 5.2).



Figure 5.1: Researcher presentation at the National Wetlands Indaba conference

SANBI (KZN) Representative Tools need to be developed with stakeholders on the ground who need to take them forward into implementation. This was not done sufficiently on the Mvoti RDM project, and this presents challenges currently being experienced with implementation. Hence with the Tugela RDM study execution was done differently with involvement and participation of UEIP, and subsequent encouragement and support of DWS KZN Regional Office with drafting the Catchment Management Strategy. 1. RSPs were only brought in at the end for review and professional presentation to polish and sharpen articulation of points. 2. This draft CMS ensures inclusion of actions for RDM implementation.	Water Research Commission (WRC) Representative 1. Why is it assumed that Regional Office will conduct implementation? Where is this mandate specified? Head office needs to take care of the full value chain in terms of ensuring implementation by specifying: • Who will conduct monitoring; • What indicators should be monitored; • Establishing whether resources are in place to take samples, analyse them etc. 2. A study was conducted to evaluate the return investment after 20 years of Reserve Determinations. Where is Step 8 done? Compliance to EWRs put in place. 3. Also, an integration issue: if Reserve, Classes and RQO projects are not conducted together, money is wasted to update components years later when the full process is done. 4. The Top to Bottom approach is not working; NPOs on the ground should be equipped to assist people to participate meaningfully. 5. Also, consideration should be given to accessibility of information: scientific language vs indigenous language. The above factors should not be assumed, head office must own the full value chain.	DWS Western Cape Provincial Office Representative 1. Regional Office is waiting for an implementation plan or a business process how RDM implementation should be done. One that outlines details such as: • Who will do what between the Regional Office and the CMA. 2. The new structure introduced in September 2022 is causing confusion on officials' roles that already differ.
DFPE (former DWS) Representative RDMs are evidence of implementation – IWRM outcome 1. They are what comes out of monitoring, stakeholder engagement etc. are done well. 2. Would there be value in them being determined by CMAs or Regional Offices as the implementing offices?	DWS (KZN Provincial Office) Representative There is a challenge with the multitude of requests from Head Office, often needing minor tweaks in format on information already provided. Regional Officials are already overloaded with work on the ground and under-resourced (staff, budget, time).	IUCMA Representative 1. Fragmentation in the reporting processes institutionally – I guess there is not enough alignment in our internal sections (such as I&P, RQM and CME). 2. Proto-CMAs need to be fully established for decision making purposes just to shorten the reporting line – Head Office independency.

Figure 5.2: Role-player inputs following study presentation at the National Wetlands Indaba conference

Figure 5.2 provides the most important data excerpts from my field recordings and represent the key insights shared by sector role-players, concerns regarding RDM, feedback on Phase 1 findings, reflection on own experiences of RDM, and learnings.

One of the major concerns shared, as evidenced in data excerpts in Figure 5.2 was the lack of implementation of RDM and institutional challenges, such as unclear roles and responsibilities, for example, following organisational structural changes. Based on these inputs, I refined my interview questions relating to RDM implementation, for further engagement during the semi-structured interviews (see Section 3.4.2.2).

These findings were analysed along with the interview data, presented next, with the analysis detailed in Chapter 6.

5.3 SEMI-STRUCTURED INTERVIEWS DATA GENERATION

Semi-structured interviews were undertaken with role-players responsible for different roles in the case studies to solicit insights into their practical experiences and learnings. A total of 20 role-players were interviewed across the case study areas (see Table 3.3); whereby two role-players were interviewed together, and the rest individually. Data was generated following clean-up of raw transcripts and review of transcripts by role-players as described in Section 3.4.2.2 (d).

Qualitative data, generated across all the interviews with role-players, were grouped together per question and is displayed in appendices 7 to 11, to hear the various voices and opinions, and generate broad themes. Experiences of role-players, relating to the same broad theme across the different questions and activity systems, were grouped together, bringing together voices from across the activity systems. Through these voices, themes started to emerge from role-players sharing motivations for their actions in RDM determination and implementation, and others sharing experiences of how these decisions made, played out on the ground. Inductive analysis (see Section 3.5.2.2) was conducted thereafter to derive sub-categories or “thematic areas” as guided by Thomas (2006, p. 245) under the broad categories of each study question. These findings are shared next.

5.4 SEMI-STRUCTURED INTERVIEWS DATA POINTS AND ANALYSIS

Thomas (2006)) suggested that:

when reporting findings from inductive analysis, the summary or top-level categories are often used as main headings in the findings, with specific categories as subheadings. It is good practice to include detailed descriptions of categories and suitable quotations from the text to illustrate the meanings of the categories. (p. 245)

Broad categories, derived from the interview questions (see Section 3.4.2.2 [e]), in turn informed by the study questions (see Sections 1.4 & 3.2), were used for grouping data relating to the experiences of role-players. Through the general inductive reading and re-reading of data transcripts, (Thomas, 2006), emerging themes were identified and coded. Though role-players made a distinction between individual and organisational learning, only emerging themes relating to the latter are detailed in Sections 5.4.1 to 5.4.14, given this social learning interest of the study.

5.4.1 Lack of standardisation of RDM outputs

As in Chapter 4, on completion of RDM determination in projects, outputs are published in a government gazette, making them legally binding and non-compliance unlawful. This places an obligation on all citizens to comply with these outcomes, that ensure water resources are protected. These outputs are also placed on the RDM website as a further platform for sharing. Role-players, however, raised concerns regarding gazetted RDM outputs.

AS1.1-RP1 and AS1.1-RP2 found that *each project's Gazette outputs are designed differently; whereby each project manager works with templates provided by their consultant team. Each consultant team's outputs format is different [due to] each consultant team interpreting the Regulations 810 guidelines differently and approaching project procedures differently*. Role-player AS2.1-RP3 also indicated that *we need to standardize our approaches to avoid confusion*. Responding to these calls for standardisation, however, role-player AS1.1-RP8 shared a contrary view, indicating that *we cannot expect standardization of approaches from*

consultants if we, [Department of Water and Sanitation - DWS], are not providing them with the tools to use. Regardless of which tools are used, provided that the outcomes respond to the intended objectives, it should not matter what tools were used or versions thereof.

Over time, comparisons can be drawn between projects conducted in the last 5 years (such as Mzimvubu, Thukela and Mvoti RDM projects) [and those] conducted in earlier projects (such as Olifants Doorn, Vaal and Olifants RDM). As an indication of organisational learnings, [recent] gazettes clearly stipulate and include all four characteristics of water courses [components] which are hydrology (quantity), water quality, habitat and biota. In the past Gazettes, these elements were not structured together and they were not easily identified by users (AS1.1-RP3). In a nutshell, role-players find the current structure of gazettes to be more user friendly. In the context of on this study, this is evidence of organisational learnings that have led to a positive change (the update of the manner in which information is presented on the RDM gazette) based on a consideration of implementation experiences, that should be continued. To this end, AS2.1-RP3 recommended that *we need to standardize our approaches to avoid confusion* [for RDM implementers on the ground].

5.4.2 A platform needed for rectifying of errors

Another issue raised by role-players is misalignments in RDM outputs, where *some elements in the technical documents have been found to not match with the Gazette details. In such cases the Gazette information is used; however, this creates uncertainties as technical reports are meant to elaborate on the information one finds in the Gazette* (AS2.1-RP3). This links to the policy challenge, found during Phase 1 document analysis, on the need for a review period to provide rectifying errors, where necessary (see Section 4.2.1.2). The current inclusion of a review period for RDM in the National Water Act 36 of 1998 (hereafter the NWA; South Africa, 1998) Amendment Bill (South Africa, 2023) is evidence of organisational learning. This amendment also supports the suggestion for some level of standardisation (see Section 5.4.1).

5.4.3 RDM outputs dissemination

AS1.1-RP8 indicated that *once the final output has been approved by the delegated authority, the RDM office communicates with all interested and affected parties (I&APs)*. However, AS3.1-RP3 shared the experience that *post the Inkomati RDM project, once the outputs were available and the IUCMA [Inkomati Usuthu Catchment Management Agency, IUCMA] as an implementer on the ground started working with the outputs to implement, the final technical reports supporting the information in the Gazette were not readily available from DWS*. In addition, *the Gazette does not provide the full duration curve, only the 60 and 90 percentile which are not achievable under specific catchment circumstances. The IUCMA in the end liaised with consulting teams to obtain information*.

AS3.1-RP3 recommended *identification of implementing role-players who need to take the work forward on the ground. Once identified, they need to be provided with a full suite of the RDM outcomes (a full duration curve must be provided) and guided on how these should be implemented (AS3.1-RP3)*.

These findings point to the need for a dedicated handover from RDM determination officials to implementing officials, where *RDM outputs information dissemination needs to be provided to the implementers on the ground; also the technical information needs to be explained to implementers; duration curves [for example] are not understood by all members (AS3.1-RP3)*.

5.4.4 Clarification of implementation roles and responsibilities

At the time of conducting interviews, the establishment of CMAs was underway in the provincial case studies. Roles and responsibilities between CMAs and provincial offices were yet to be clarified in areas where CMAs were not yet functional. To this end, AS2.1-RP3 indicated that *KZN has not implemented RDM outputs yet due to implementation challenges between the CMA and Provincial Office whereby there is a disconnect between them attributed by this role-player to a misperception that everything needs to be implemented by the CMA*. AS2.1-RP3 went on to elaborate that *there are systems that operationally reside*

with the provincial office main account such as the Hydrological, Geohydrological and River Health systems; it needs to be operationally made clear that the Provincial Office needs to conduct the work on these systems, and that they have a role to play. AS2.1-RP3 advised that implementation requires integration between the provincial office and CMA; and that there needs to be clarification of roles.

5.4.5 Transition to implementation actions

AS1.1-RP8 indicated that the official transition from RDM determination to implementation is currently missing and it needs to be factored-in [to the RDM process]. Currently, the RDM team works with the implementation team [mainly as part of project committees] throughout the study process.

Another role-player (AS2.1-RP3) elaborated on this point, noting that regional authorities [provincial officials responsible for aspects of RDM implementation] need to work in an integrated manner for greater impact. It is evident that various units within DWS (in the Provincial Office, Proto-CMA) and Municipal institutions are focused on their own mandates; and efforts are not aligned, evident in the lack of implementation to date. What is needed is clarification of roles and responsibilities; and articulation of implementation actions and clear demarcation of roles and responsibilities (AS2.1-RP3).

In addition to the above, AS2.1-RP3 felt that an implementation guideline is needed to provide:

- *practice implications of the outputs, in a form of a guideline into practice document as these outputs would mean different things for different implementers. As an example, monitoring programmes would consider different elements compared to an Integrated Development Plan (IDP);*
- *demonstration in a practical guide on how the RDM outputs should be translated into an implementation plan; [and]*
- *a procedure to determine how to utilize RDM outputs.*

5.4.6 Need for functional technical tools

Functional tools are a necessity for the execution of tasks in RDM determination and implementation. These are inclusive of computers, computer programmes and field equipment, as some examples. AS1.1-RP7 elaborated that *to execute high confidence RDM projects, functional models are needed. We need to develop adaptable models for long periods to cater for technological software updates and changes. An example is that in the past the Rivers Database was very good and used effectively; now there is the new version of SPATSIM which doesn't work on older machines; so even if one was trained and knew how to use it, the machine would not be compatible.* This is an example of an organisational change that did not seem to take what was working and enhance it, but rather, replaced it, possibly for good reasons. This change took away existing functional capacity which resulted in the need for new learning. It also relates to the next large category of data points, which all mentioned data related challenges, discussed further in Section 5.4.7.

AS3.2-RP2 indicated that *institutionally, multiple tools [are needed] at all levels, hence RDM implementation requires capacity in the form of tools.* To offer explanation on the tools challenge, AS1.1-RP4 indicated that *resources are not there [in the organisation] to mobilize implementation because they have not been built over time.* AS1.1-RP3 shared that *now development of models to assist with interpretation of outcomes are being considered.* The role-player mentioned *Decision Support Systems for Reserve implementation* as such a tool.

AS1.1-RP10 indicated that *Project Managers don't challenge it [the lack of standardisation of tools and approaches used to follow the step-by-step RDM determination guidelines stipulated in Regulations 810] because they don't have the required tools.* In disagreement with the desire for the standardisation of tools and approaches, as above AS1.1-RP8 indicated that standardisation can't be expected if DWS does not provide the necessary tools (see Section 5.4.1). This role-player further elaborated that *how the steps are executed [followed] by consultants or the methodologies used are not dictated because the tools are not provided by the DWS side.*

AS1.1-RP9 made an example that *the lack of tools such as real-time systems installed by the IUCMA alongside lack of knowledge, results in all [water use] applications being approved and ultimately over-abstraction of resources.*

Role-players made the link between implementation tools and RDM outputs and identified the need for incorporating the latter into the former. AS2.1-RP3 indicated that *the relevant RDM outputs details need to be included in key implementation tools such as the DWS Reconciliation studies, where the details of RDM need to be clear in the documents and not only a high-level mention.* This role-player added that *Municipalities do not incorporate them in their tools, IDPs [Integrated Development Plans, which are planning tools for municipalities] are silent on RDM.*

AS1.1-RP9 indicated that learning [also] *needs to take place at community level as well. We need to develop tools to capacitate people on the ground.*

5.4.7 Data challenges

As before, data acquisition and management plays a crucial role in water resource management (see Section 4.2.3.1 [a]), including water resource protection through RDM. It determines the quality of information generated for water-related decision making (South Africa. DWS, 2023). Data, as a key theme, emerged early during role-player interviews and prompted me to probe the factors underlying its quality, management and accessibility. Role-player AS1.1-RP5 provided input from the DWS Data Management Strategy for Water and Sanitation in South Africa (DWS, 2019) which highlights the following challenging factors pertaining to data:

- *Insufficient human capacity, whereby there is a shortage in the number of suitable skilled staff at Provincial Offices to perform and manage data processes. This is caused by [a] lack of filling of vacant positions resulting from resignations and retirements, lack of transfer of skills from senior officials and contractors and lack of continuous training of officials on the scientific aspects behind the collection, validation, and processing of data.*
- *Inaccessibility of water quality and quantity data collected by consultants.*
- *Lack of adequate data collection skills in Municipalities.*

- *Delays in procurement of instrumentation resulting in the lack of hydrological instrumentation used to collect data.*
- *Delays in the renewal of laboratory contracts impacting sample analysis due to uneven availability of access to accredited laboratories.*
- *Some water quality data stored in Data Management Systems (DMSs) with errors – there are instances where data is stored without validation posing a risk on decisions taken using such data leading to errors and ultimately negatively affecting credibility.*
- *Some water quality and quantity data not stored in structured DMSs. There is data stored in personal computers, hard drives and as hard copies among DWS staff making it not easily accessible, compromising the security of critical and sensitive data. An example shared in this regard was that some of the data required for generating information for river health and ecostatus in rivers, point and non-point pollution sources and state of water information is stored in personal computers across the different business units and regional offices in DWS, other departments and independent research organisations.*
- *Underutilisation and non-utilization [sic] of the Water Management System (WMS). It was found that WMS is not fully utilized and, in some cases, not utilized at all at some Provincial Offices due to perceived lack of user friendliness. Hence, some provincial officials from various DWS regions do not know how to capture water quality data into the WMS. It has been reported that some water quality data collected in DWS regions has not been stored into the WMS for years due to this challenge.*
- *Vandalism of instrumentation and lack of access to private land. In a number of incidents across South Africa, instruments for water resource monitoring have been vandalised where they are openly accessible by the public. On the other hand, some monitoring points such as boreholes are located on private land and inaccessible to officials due to locked gates or access refusal by private landowners. This points to the need for strong stakeholder buy-in into water resource monitoring.*
- *Most water quality and quantity DMSs are dated. The Integrated Water Quality Management Strategy (IWQMS) and the Data Management Strategy (DAMS) report that most of the DMSs used in DWS are old and inaccessible to support adoption of latest methods and techniques for water quality management such as citizen based monitoring.*
- *Reservoir data collected by Municipalities not accessible to DWS.*

- *Lack of cooperation and collaboration between the DWS and Water Sector stakeholders for:*
 - *sharing and monitoring infrastructure;*
 - *data acquisition and management of functions resulting in duplication of efforts between DWS and other institution;*
 - *common approaches for resolving data needs and issues; [and]*
 - *lack of standard, repeatable processes for generating and disseminating data.*
- *Lack of structured DMS in DWS for wetlands data. Wetland data acquisition, storage and management are a relatively new mandate of the DWS and as a result it is the least developed field. No previous assessments of the data and information required by the DWS for wetlands has been undertaken. Although DWS has yet to implement the wetland health monitoring programme and wetlands still need to be integrated into catchment management plans, the DWS determination of management objectives and authorisations of water uses that impact on wetlands has been undertaken since its mandate for managing wetlands arose in 1998 (for the past 20 years) so as to contribute to information on the state of wetlands in South Africa and to improve decision making by DWS and its institutions with regard to wetland management. The variety of data required include research, RDM, GIS, ecosystem services, compliance monitoring and enforcement, wetlands health monitoring, wetlands use authorization, offsets data, hydrological, and water quality data. Moreover, given the intergovernmental nature of wetland management, where both [Department of Forestry, Fisheries and Environment] DFFE and Department of Agriculture, Land Reform and Rural Development (DALRRD) also have mandates to sustainably manage and protect wetlands, numerous data from other government departments (in particular data from [Agricultural Research Council] ARC, DFFE Working for Wetlands and [South African National Biodiversity Institute] SANBI) are required to ensure alignment and integrated decision making.*

Evidently, the theme of data challenges would require a whole activity system analysis on its own. It was for this reason that I only explored it for illustrative purposes to understand how data affects many aspects of RDM, and not in further detail. Input on the DMS, shared by the role-player, shows that all the data challenges, as presented above, play a role in the RDM

case studies. In addition, the lack of a dedicated platform for depositing RDM data, post projects, has led to a data acquisition challenge for the organisation post RDM projects. AS1.1-RP6 illustrated the gap when indicating that *we have also learnt that we need raw data in a format that can go into [Present Ecological State, Ecological Importance and Ecological Sensitivity] PESEIS database; example: FIFA (Fish and Vertebrates data).*

AS1.1-RP10 further confirmed that *the acquisition of data generated during the RDM project is a challenge, consulting teams leave with it. In response, recent Terms of References and Contracts with consultants explicitly call for data submission to the DWS as a deliverable.* A project on the RDM Decision Support System has been initiated to provide a platform for these data submissions by consultants and has been in development for the past five years. This is a demonstration of organisational learning, where a need has been identified and initiatives are in place to address it.

5.4.8 Recruitment of human resources and appointment of consultant teams

AS1.1-RP7 asserted that *one needs to be suitably qualified with relevant technical background to lead technical work.* This applies to both appointed consultants and staff members. A lack of understanding of the technical environment on the ground can become a barrier for effective execution of the technical work, negatively impacting on service delivery, for example water provisioning. This role-player felt strongly about the need to ensure good capacity for the work in hand, noting that: *human resources should be recruited and appointed in terms of suitability of qualification and experience and not based on gender, race or political affiliation. It should be about fitness to hold office (AS1.1-RP7).*

Highlighting other dimensions of the human resource challenge, AS1.1-RP6 indicated that *the DWS procurement processes to appoint technical skills are hindering efficient progress and they need review. Supply Chain Management [SCM] listing has inappropriate service providers that are not accredited for the technical work required for RDM studies; hence when RDM procures technical consultants [from the available list] the procurement process is flawed.* The role-player elaborated that:

- *the team composition and experience should carry more weight; however, this is not the case. The cheapest bidder goes through regardless of these critical requirements [team composition and experience]; as a result, a project ends up with consultants that can't do the work.*
- *SCM is more worried about BEE requirements than specialization, [and]*
- *the adjudication committee also needs to be appropriately experienced to participate; otherwise, inappropriate scoring happens.*

Moreover, there is no process for checking the quality of the work produced. Example, RDM outputs translated by a service provider, who checks that the (e.g. isiXhosa) translation was accurate? (AS1.1-RP6).

5.4.9 Capacity building

Capacity building among the project team assigned to undertake the RDM process is a key requirement, reflected in project terms of references, noted in inception reports, and reported in close-out reports. However, whether capacity is being built over time and how efficient the processes are is not evident in the overarching National Office study case, given the ongoing outsourcing of all technical work components to external consultants. Internal to DWS, role-players indicated that the nature of the work allocated to them tends to be largely administrative, pertaining to managing projects. On-the-job opportunities for conducting technical work are limited.

According to AS1.1-RP4 technical tasks are being conducted by consultant teams; staff members are not given opportunities to be hands-on. Aligned to this view, AS1.1-RP7 indicated that the work being conducted in-house is administrative with technical components being outsourced. Role-players elaborated on this, indicating that [learnings are mainly attributed to managing projects], now majority of staff members have experienced Project Management roles and learned key skills from compiling terms of references, project coordination, tracking deliverables or project progress and the project technical process (AS1.1-RP10). They were of the view that on the job learning requires hands-on participation because people learn as they do or undertake projects. The more they do, the better the understanding of the process which makes it easier to lead in other new projects (AS1.1-RP8).

Furthermore, this role-player was of the view that *it doesn't make sense to still be outsourcing when there are technical personnel within the units. Initially, the aim of outsourcing was to address lack of experienced trained personnel; unfortunately, with time, the outsourcing continued as a norm. And once staff were in place, the request was for consultants to transfer skills* (AS1.1-RP4).

Role-players were of the opinion that learning opportunities do exist within RDM, during the execution of outsourced funded projects. AS1.1-RP7 explained that *capacity building sessions are included in funded RDM projects, whereby identified staff join consultant teams on fieldtrips to conduct field assessments and where capacity building sessions are scheduled as part of the project. Such capacity building sessions are fruitful, by attending such fieldwork sessions or site visits staff learn practically about different assessments alongside tools that are needed to conduct them* (AS1.1-RP7). This role-player attested to valuing participation in capacity building sessions of this nature and expressed that the *experience and exposure influences quality of work* (AS1.1-RP7). Similarly, AS2.1-RP3 indicated that, *internally it would be great going forward if DWS staff are seconded to work alongside the consultant in their respective areas of interest. You learn by doing. The one or two training gives a broad overview but it is a lot to digest in a short period of time.*

Among the challenges for capacity building, some role-players indicated that capacity building opportunities are not always taken up by staff, and in some cases, are not necessarily supported organisationally. Operational processes in organisations, such as, work area demarcation, travel approval procedures and funding limitations, hinder participation in valuable hands-on capacity building opportunities such as fieldwork. In addition, one role-player indicated that *there are challenges with coordination of capacity building in terms of identification of participants and allocation of capacity building areas of participation for identified capacity building personnel* (AS1.1-RP1).

Internally in DWS, another factor experienced as influencing capacity building is the lack of platforms for sharing lessons post RDM determination (see also Section 5.4.13). Nonetheless, strides have been made towards capacity building. Role-players cite the recent RDM

interpretation workshops for information sharing sessions with provincial offices as a positive learning platform.

On the other hand, role-player AS1.1-RP2 argued that *it is not an issue of lacking skills, all expertise sought from consultants are available within DWS, however it is scattered everywhere in different Directorates*. While role-player AS1.1-RP6 was of the opinions that *at National Office level in a National Department, we develop policies, guidelines and strategies. It is not our role to perform technical work. There is only a handful of specialists within DWS that can run models and process Reserve Hydrological data. We don't have the required skills to run models; perhaps a few staff members in Planning might, however this is a significant gap.*

- *As an example, qualified hydrologists, vegetation specialists are what is required which are not available in-house. These skills fit in Regional Office and not in Head Office where the focus is development of guidelines, strategies, policies etc.*
- *Another example is execution of the revised desktop model, SPATSIM. Although officials were sent for training on this model they still can't use it.*
- *Why are we not having people that can run models in Regional Offices to deal with Water Use License Applications (WULAs)?*
- *Regional Offices should do their own comprehensive Reserves and provide all the data to Head Office. Head Office would still need to review and approve. Accumulative impacts need to be taken into consideration. General Authorizations (GA) get issued but they are hardly reviewed over time to determine if they are still environmentally sustainable.*
- *As an example, an area that has an approved GA and later-on demarcated as an offset (rehabilitation, restoration intervention); how do we deal with ensuring that no more is taken? This needs to be gazetted to ensure protection (AS1.1-RP6).*

In addition, AS1.1-RP6 indicated that several factors contribute to ongoing capacity challenges including:

- *inability to execute technical work;*
- *lack of in-practice experience;*
- *unwillingness (lack of dedication to the trade); and*

- *lack of technical components (for example, for working out WQ loads in the provincial offices).*

This role-player concluded that *development of policies, guidelines and strategies as per National Office staff mandate appears to require execution by staff members that have practical experience of the problem (AS1.1-RP6).*

Capacity, and whether there is indeed a lack, is clearly a significant theme and will be analysed in some depth in Chapter 6. Another significant theme that emerged from the role-player data, namely stakeholder engagement, is introduced next.

5.4.10 Stakeholder engagement

As confirmed by the document analysis in Phase 1, stakeholder involvement and public participation are key aspects of RDM processes, ensuring involvement of interested and affected parties (see Section 4.2.3.1 [b]). How stakeholder engagement is executed, and its effectiveness, is a major emerging theme in the study. As the following role-player perspectives show, with some opposing views.

Some role-players believed *public stakeholder engagement is executed sufficiently within RDM projects (AS1.1-RP3, AS1.1-RP8).* AS1.1-RP8, for example, elaborated that *we [DWS] have various stakeholder meetings that we make provision for to ensure we leave no stone unturned. Furthermore, we rely on Provincial Offices to convey the message to their Catchment Management Forums. We also participate in other projects outside RDM where we provide information about the RDM projects (AS1.1-RP8).* Other role-players, such as AS1.1-RP10, disagreed, indicating that *stakeholder engagement is not executed sufficiently, as stakeholder engagement meetings with the general public are undertaken in the beginning of the study (to announce the project) and later in the study (to communicate project outputs). In between people are not consulted. Moreover, the audience that attend is always the similar crowd, such as NGOs, environmental institutions, academia etc. Community members and the real people that are affected are not there, they do not come due to several possible reasons*

such as the complexity of the project content, language barrier (the meeting doesn't usually include local language interpreters) and lack of awareness.

AS1.1-RP3 agreed with this view, explaining that *the challenge is the scientific nature of the projects whereby even some academic stakeholders do not understand some contents (AS1.1-RP3). AS1.1-RP4 further noted that community stakeholders on the ground often don't possess water expertise; they only understand water supply challenges in relation to their lived experiences; or needs. They, therefore, can't engage in RDM stakeholder meetings, they know nothing about the technical work being done. Information to these stakeholder needs to be simplified in a form of citizen science (AS1.1-RP4). AS1.1-RP6 outlined another dimension, that stakeholder engagement is not working properly, and highlighted the following challenges with how stakeholder engagement is currently executed.*

- *DWS provides platforms and opportunities for stakeholders to voice their concerns; however, the outcome that is derived from these sessions is later captured to say stakeholders agreed.*
- *Stakeholders bring all water related issues to the sessions, even the ones that are not the focus of the sessions (i.e. conflicts on water use license applications not approved) and they thereafter boycott the process during 60-day review period.*
- *You find two extremes of stakeholders participating in the process: on the one hand it is members of the public who do not understand or know what the process is about; vs on the other hand, retired experts and NGOs who are well knowledgeable but disruptive, they participate to be auditive and come into the process with a pre-set negative mind.*

Role-player AS1.1-RP10 explained that *a contradiction here is that the [RDM] process requires extensive stakeholder engagement to be conducted but the actual process does not adequately cater for this. When I prompted why this is, the response was this is due to budget constraints. We are now budget orientated at the expense of key activities such as stakeholder engagement and capacity building; and even the studies themselves (area coverage, level of execution such as high confidence) [are compromised].*

AS1.1-RP8 went on to outline a recent change in stakeholder engagement where *RDM project managers no longer attend forums to engage stakeholders; they instead train regional officials on the RDM content to ensure they take the information forward. This has been beneficial in terms of cutting costs and capacity building for regional officials to understand project outcomes.* AS3.2-RP1 confirmed this change, however, disagreed with the second point, on capacity building, citing the following case example.

In the Olifants Proto-CMA, there is no implementation of RDM outputs so far, although the Gazette has been published for many years. We only put a statement in the license conditions about RQOs [Resource Quality Objectives] which stakeholders and CMFs have indicated that they do not understand. Upon request [by the proto-CMA] to the RQOs office for them to come and present and explain to stakeholders, we were told that stakeholder consultation meetings (public participation) were conducted in the area and the office can only prepare a presentation to provide to the regional office staff to present to the CMFs. I am a CME official, on the authorization side, I wouldn't be able to deliver such a presentation to the CMF (AS3.2-RP1).

What this example indicates, is the lack of understanding of RDM outputs by provincial officials and the need for support from the National Office to engage stakeholders and explain the RDM outputs. This also indicates the National Office expectation of provincial officials to take the process forward without sufficiently equipping and training them to do so.

Role-players made the following recommendations for stakeholder engagement in RDM processes:

- *A revised public participation guideline is needed for technical studies (AS1.1-RP6) with the revision focussing on ways in which participation should be undertaken.*
- *It would work better if those stakeholders that have and can use online platforms (i.e. Teams) could use it and participate (AS1.1-RP6).*
- *Learning needs to take place at community level as well. We need to develop tools to capacitate people on the ground. Community engagement should:*
 - *take them through a process; and*

- *embrace that the learning systems of deriving meaning [among communities] are different [from those used by scientists];*
- *engage with things people value;*
- *ensure that we engage with people in a manner that has meaning to ultimately ensure water resource protection (AS1.1-RP9).*
- *Citizen Science could assist with data provision and implementation of wise land-use (AS1.1-RP9).*

AS2.1-RP3 called for a tailoring of participation for members, internal and external to the RDM process indicating, *for participation within each organization, multi-disciplinary team of stakeholders needs to be engaged per organization to ensure that all the elements of the RDM process are engaged with by the relevant staff members (such as hydrology vs water quality vs planning), one person is not a specialist in all aspects. This will assist in [for] example, avoiding the exclusion of variables. Also, within each team, two to three representatives are needed to ensure continuity of the work and knowledge of the unit even in the event of staff turnover or relocation of a staff member that participated in the process.*

[With regard to] *participation of key implementing entities and stakeholders,*

- *Municipalities do not participate in the RDM determination process, even though they are invited. This results in them not understanding the implications of the [RDM] outputs.*
- *Engagement of community stakeholders is critical for ensuring land-care management practices and protection of water resource management tools (such as curbing vandalism).*

AS3.1-RP4, regarding the nature of stakeholder engagement, recommended that:

- *During stakeholder engagement, it needs to be clear what stakeholders are being asked to participate in.*
- *Sharing information with people is one thing and it is only a starting point for a certain purpose [in other words, more is needed beyond sharing information].*
- *Knowledge sharing is another thing, people should be enabled to think what they should do with the knowledge. We should aim to:*
 - *engage for behavioural change;*
 - *explore how people learn;*

- *get people involved; [and]*
- *avoid extractive approaches.*

AS3.2-RP2 thought that *there are a lot of opportunities that exist, the [RDM] studies need to involve communities. Currently as things stand information is merely shared with communities, I have never seen involvement of schools, community leaders. A lot of indigenous knowledge systems lie with them, and this knowledge is currently not being integrated.*

Internal to DWS, AS1.1-RP9 shared that *the recent rolling out of RDM interpretation and application workshops to Provincial Offices by project managers [an initiative for sharing RDM information from the head office officials with provincial counterparts] has provided a platform for learning within the organization. During these workshops learning was experienced in two ways, through RDM Team preparations and anticipation for session questions, and through consultations that were held with the IUCMA and Kruger National Park staff for sourcing information (such as load calculation and practical ways of implanting RDM).* AS1.1-RP9 elaborated that *these workshops provided a platform for National to Provincial impact and they were conducted for all the regions. Provincial officials who had no prior knowledge of RDM processes, in the end had an understanding of where RDM fits into the jobs they do.* Role-player AS2.1-RP3, who had just heard about the workshops at the time of our interview, and had not yet attended one, thought that *it would be a good opportunity to have a symposium or a workshop to discuss and share lessons learnt [regarding RDM processes]. This should be documented, and key areas of improvement identified, with actions to streamline and improve areas of concern.*

We see here that role-players have mixed views on whether stakeholder engagement, in its current form, is adequate or efficient for achieving its intention. Concerns are mainly about frequency of, and the level of complexity, during engagement. There appears a need for different levels of engagement with different groups of stakeholders, and a consideration of the nature of engagement, such as information sharing, seeking input or capacity building for pollution prevention. It appears that a targeted stakeholder engagement plan, per project, is

needed to enable differentiated levels of engagement, responding to purposes, both internally and externally to the organisation. Role-players also identified the need for a revised public participation guideline for technical studies.

5.4.11 Partnership and cooperative governance

There are interlinkages in the internal work of DWS, among the various organisational units. This is also the case, externally, between DWS and other organisations with a shared water resource protection mandate. Role-players referred to these interlinkages when commenting on their experiences and learnings. For example, these *interlinkages call for cooperation in working together to achieve the broader goal of sustainable water ecosystem management* (AS1.1-RP7).

Role-player AS1.1-RP8 attested to this, noting that *we all want what's best for our water resources* and further indicating that *internally, on an organisational level we are learning the importance of cooperative governance, that we need to work as teams and cooperation is needed between the different Directorates, as the different components of our work is interlinked. As an example, data collected by RQIS [Resource Quality Information Services] is critical for feeding into RDM projects; similarly, Reconciliation projects conducted in Water Resource Planning are critical in RDM projects. Therefore, we are all interlinked internally, however we don't fully understand how we each fit in the puzzle. Given that we are responding to many things, we need a central hub where it all comes together; and to teach each other on how the respective roles of our individual units fit into the puzzle. An example is the importance of water ecosystems management to ensure healthy water resources in the ultimate water service provision; if water resources are not protected or conserved; there will be no water for water services provision [delivering drinking water]* (AS1.1-RP8). This role-player was emphasising that different units within DWS need to understand the work of the other.

Evident to the interlinkages that exist with sector institutions, DWS uses data from other institutions, with the shared water resources protection mandate, during RDM studies. Several role-players elaborated on the nature of the data that needs to be shared, namely *data on status of rivers, wetlands, estuaries and groundwater in terms of water quality data,*

ecosystem health, hydrology, population census surveys, NFEPA [National Freshwater Ecosystem Priority Areas] Biodiversity priority areas and ecological status. This could be monitoring data and research outputs and the institutions with the shared water ecosystem management mandate that share the data include DFFE, ARC [Agricultural Research Council], DMRE [Department of Mineral Resources and Energy], SANBI, Stats SA [Statistics South Africa], Research Institutions, SANParks [South African National Parks], other Conservation organisations, academic institutions, WRC [Water Research Commission], NGOs, as examples (AS1.1-RP3, AS1.1-RP4, AS1.1-RP6, AS1.1-RP7, AS1.1-RP8 & AS1.1-RP10). Water resources are also shared with neighbouring countries, therefore RQOs need to be linked to cross-border flows [and included in organisational implementation plans] (AS3.1-RP3).

As further evidence of existing and important interlinkages with sector institutions, role-player AS1.1-RP8 attested that *working with catchment stakeholders brings the wisdom of what goes on in the catchment and the history behind it. This helps in understanding the current status and navigating towards setting protection measures that will allow the resource to thrive and provide the goods and services that users derive from it* (AS1.1-RP8). In addition, AS1.1-RP10 raised the issue of financial resources, as well as stakeholder concerns regarding water quality and quantity, noting that working together, externally in the broader environment, *ensures that the water sector is in alignment regarding challenges related to water resources. To some level, it assists with mobilization of funds to undertake necessary projects, outside of government financial resources. In almost all projects, the DWS involves stakeholders, interested and affected parties. Over the years stakeholders have come [on board] because they can observe deteriorating water quality and over-abstraction locally and they want to bring these issues to the DWS' attention, mainly through platforms such as project meetings and different forums* (AS1.1-RP10).

Evidently, working in cooperation with one another is needed both internally within DWS and externally with sector organisations with a shared mandate. There are currently platforms for enabling this collaboration, but more can be done. Internally within DWS, role-players were of the view that *working together ensures optimal deployment of resources and avoids duplication of work* (AS1.1-RP10). Externally or sector-wide, role-players felt that

collaboration needs to be supported by the organisation in order for efforts to be made to take up opportunities (AS1.1-RP4).

5.4.12 The RDM determination and implementation challenge

To some extent, these foregoing findings already point to challenges. Role-players, however, also reflected on challenges in the process of determining RDM and for the expected implementation of related outputs, once they are in place.

AS1.1-RP4 emphasised the need for putting resources in place to enable RDM determination and indicated that *financial challenges or departmental rules on staff travel are impacting on execution of work*. The role-player made an example that *currently, only two people are permitted to go to site [on fieldtrips] which doesn't suffice for execution of the work as it is impossible for two people to conduct a rapid reserve [determination]; and risky from a safety point of view*. In addition, AS1.1-RP4 was of the view that *resources should be built over time*. Similarly, in terms of the need for resourcing functions, role-player AS1.1-RP6 indicated that *some functions are developed and approved at national level for implementation at provincial level, however, the functions don't go with the funds and personnel that should execute them*. AS1.1-RP6 explained that *an example in this regard is the management of estuaries, whereby expertise and funds are lacking for [the] execution of estuarine management plans, [the pollution of] which is a major detriment to the environment*. AS1.1-RP6 emphasised that *work functions need to be sufficiently resourced with qualified people who have the relevant expertise*.

Role-player AS1.1-RP6 went on to make recommendations for the RDM determination process as:

- *Implementing officials should be involved in the development process, involvement in the stakeholder participation process is not enough for preparing for implementation – a transgressional/ sequential / transitional process is needed. As examples:*
 - *We write Ecospecs [ecological specifications] from a technical viewpoint, they [Provincial Officials] put it as is in the water use license conditions, it becomes generic.*

- *The scale of the RQO is too big for RAMSAR [a wetland site designated of international importance under the Ramsar Convention, an international agreement promoting wetlands conservation] level. We need a rule for Ramsar sites to be an IUA [Integrated Unit of Analysis, meaning a management unit] for setting specific conditions for them [as they are wetlands of international importance]. Similarly, as done for Estuaries.*

Until recently, on-the-ground implementation of RDM outputs were not evident. Role-players observed several factors hindering implementation. One of these is the actual understanding of what needs to be done, by personnel who have until that point not been involved in RDM processes. Explained by AS1.1-RP1 and AS1.1-RP2, *implementation is mandated to provincial offices in terms of the institutional design; however, during the course of the RDM [determination] project, provincial office personnel are sometimes not fully involved, or their involvement is secondary with limited interest; as [these] personnel have [other] core functions being prioritized.* AS1.1-RP1 and AS1.1-RP2 were interviewed in one session and they indicated that *this [the point they raised above regarding involvement of provincial officials] presents a challenge for implementation later, in terms of understanding of RDM project outcomes.* In addition, AS1.1-RP10 indicated that *very few of RDM measures are being monitored [monitoring programmes not incorporating RDM outputs], as mobilization of resources is only now starting to take shape with CMAs being established.* Adding a deeper reflection on the matter, AS1.1-RP8 indicated that *whether the term 'implementation' is appropriate is also questionable, perhaps "monitoring compliance" should be used.* What this role-player had in mind, is that implementation of RDM is dependent on overall catchment management, involving various activities, such as water resource monitoring to check compliance with RQOs and water resource health or ecological status, followed by an investigation of pollution sources if the RQOs are not being met. This should be followed by compliance monitoring to check whether users have authorisations and whether they are meeting their water use license conditions.

The RDM interpretation and application workshop initiative with provincial offices (see Section 5.4.9), was cited by role-players as a positive response for addressing RDM implementation challenges. However, AS1.1-RP7 believed that *consultant teams should be*

included as the people that executed the technical work. During these workshops, role-players have indicated that the implementation of RDM outputs are hindered by:

- *human resource capacity challenges due to staff-turnover and budget constraints preventing the filling of vacant posts (AS1.1-RP3); [and]*
- *complexities of the process in determining how the outputs translate into license conditions (AS1.1-RP3).*

AS3.2-RP2 shared the following, based on experiences at provincial office operational level:

- *There is a big difference between implementation and monitoring. The two tend to be confused; where entities are conducting biomonitoring, it is not necessarily RDM implementation.*
- *Implementation on the other hand involves both monitoring to identify the status [of the water resource, such as the ecological status in a river] and where unacceptable taking decisions to manage the resource. As an example, DWS has weirs in strategic areas within IUAs; in terms of flow, the weirs monitor for hydrology and resource managers evaluate the monitoring data in terms of the expected low flows or high flows. Where insufficient, water releases are implemented (as an example through operating rules where there is a Dam) or restrictions where it is due to over-abstraction.*
- *In terms of Water Quality, indicative variables should be identified and managed.*
- *People think CMAs will be able to implement RDM and that is not so because they will just take over some functions of the Provincial offices or Proto-CMAs such as Regulation, Planning. The current institutional setup is not geared to deal with RDM and hence the resulting misalignment. The RDM function is currently not performed in the provincial offices because it was seen as a centralized function at head office level. It will take time before the CMAs are fully functional and in some cases staff may need to be moved from Provincial offices, therefore people would need to be capacitated. As it currently stands, RDM is outsourced within DWS even at Head Office level, hence capacity to execute RDM is not available at all levels (Head Office and Provincial Office levels). Multi-expertise is needed at all levels and multiple tools.*

- *Reserve implementation is currently happening incorrectly; and only the quantity component is being implemented from the point of view of operating rules (releases where there is a Dam or restrictions where there is over abstraction).*

The role-player (AS3.2-RP2) went on to make recommendations as quoted below:

- *Implementation [of RDM outputs] requires assessment of the situation and putting management measures in place. This requires capacity (tools, expertise, funds). Capacity exists, but it lies elsewhere, with the DFFE within their Park authorities and Conservation Management divisions, however they also work within their boundary areas. Ironically the River does not conform to these boundaries.*
- *Inter-relations between DFFE and DWS exist but we fail to see them. A Memorandum of Agreement needs to be put in place or it must be captured in the legislation to enable action to happen for implementing RDM.*

Role-player AS3.1-RP4 shared perspectives and indicated that *implementing RDM requires implementation of catchment management through the Catchment Management Strategy (CMS) and that delivers RDM, such as the Reserve. What is needed is a functional government structure to be put in place and the implementation of the CMS. Without that intermediary, catchment management and SDM [Source Directed Measures] are unlikely.*

As possible evidence of organisational learning, a target on the compliance monitoring of the implementation of RQOs [the outputs of RDM which are broken down into variables that ought to be measured in the water resources, as in Section 2.3.1.4] was added to the DWS Annual Performance Plan (APP) for the first time in the 2022/2023 financial year. In response to the APP target, the Water Use, Compliance Monitoring and Enforcement unit within DWS National Office recently started an RQO compliance monitoring initiative. AS3.1-RP1 outlined the motivations of this initiative as follows:

- *monitoring of compliance to the RQO will help improve the status of the country's water resources. This comes behind the background that RQOs have been determined and gazetted for most Water Management Areas in the country; but little has been done to implement and monitor RQO compliance;*

- *enable the modification of programmes for resource management and impact control as and when necessary; [and]*
- *it will also assist in completion of the adaptive management cycle as indicated in process of determining RQO.*

As further examples of organisational learning, role-player AS3.1-RP1 indicated that:

- *This new APP target on compliance to RQOs has triggered new activities for the RDM compliance monitoring which has led to initiatives to monitor RDM compliance, and RDM interpretation workshops on the application of RDM templates by Regional [Provincial] Offices.*
- *Now development of models to assist with interpretation of [RDM] outcomes is being considered.*

As part of the RQO compliance monitoring activity, responding to the above mentioned APP target, role-player AS3.1-RP1 shared some practical lessons learnt from the Inkomati Usuthu Catchment Management Agency (IUCMA), on completion of the RQO compliance monitoring:

- *As part of the work to understand and implement RQOs, the IUCMA communicated directly with the consultants who conducted the RDM project in their area.*
- *Challenges experienced with the Gazette [include:]*
 - *variable (turbidity) [has] no numerical limit which makes it difficult to assess water quality compliance.*
 - *not specifying which toxins to monitor [hence the] IUCMA prioritized toxins according to the catchment specifics [but the Gazette does not specify this].*
- *Some EWR [Ecological Water Requirements] points specified in the Gazette are not correlating directly with the monitoring points from the IUCMA [hence] alignment of monitoring points had to be done [by the CMA].*
- *Naming of provincial monitoring points to change to EWR site points was tedious – needed working sessions to understand.*
- *Inaccessibility of monitoring points – accessible points had to be selected instead.*

Role-player AS3.1-RP1 made further recommendations:

- *The IUCMA re-hiring the consulting teams that conducted RDM in their area was seen as incurring more costs as they are paying the consultants for RQO meetings and trainings. A proposed solution was for RDM to have the champions for each gazette to train and give support to regions and CMA when implementing.*
- *Sharing of knowledge makes the process easier. [The] recommendation [is] to request the IUCMA officials to help the regions that are in need of information on implementing RQOs.*

A picture emerges from this section that the implementation mandate rests with provincial institutions, including provincial offices and CMAs or Proto-CMAs. This becomes unattainable where the mandate is not accompanied by institutional resources and structures with clear roles and responsibilities. Role-player AS1.1-RP3 summarised many others' inputs well when indicating that *policy and institutional short-comings play-out operationally*, [providing an example that] *in previous RDM projects, the lack of a definition for the word 'significant' in the policy led to the exclusion of Dams whereby the NWA stipulates that 'all significant water resources must be classified', it however did not define the meaning of significant and in the past this rendered these water resources left out of RDM projects*. The importance of dams, as part of water storage infrastructure, is significant for water supply in South African conditions because of the unevenly distributed and variable rainfall. On the other hand, their environmental impact is just as significant. Hence, their inclusion in RDM projects is crucial for setting management measures to cater for ecological functioning of water resources where dams have been constructed.

The role-player further elaborated that *the matter was subject to interpretation from one project team to the next*. Institutionally, the role-player indicated that *slow establishment of CMAs has resulted in RDM implementation failure and challenges (AS1.1-RP3)*.

In addition, AS3.1-RP3 expressed that *the challenges being experienced have nothing to do with the technical work, it all pertains to the institutional systems that have been put in place and whether they are being followed. As an example, there are water users that have historical existing licenses that were issued before RDM were put in place. The users will be discharging*

loads that are exceeding limits and their justification is that they are permitted to do so in their license. Authorities need to review licenses after five years, now that RQOs are in place these licenses should be updated, however, this is not being done.

5.4.13 A more formal platform is needed for learning

AS1.1-RP3 highlighted that how projects have been conducted in the past 5 years is very different from earlier (as an example, 10 years ago). In support, AS3.2-RP2 elaborated on this in, if you look at the early years, 2002, only rapid Reserve studies were conducted, and these were not as detailed as the studies we have now. Earlier studies were of low to very low confidence and subsequently decisions were made on low confidence information. The impacts were huge leading to various paradigms [consequences] such as a river running dry due to decisions made based on low confidence information.

However, AS1.1-RP1 and AS1.1-RP2 both noted that *there are no platforms for sharing these learnings [or exploring lessons from previous processes] for consideration of doing things differently for future projects. After all projects, [internal to DWS Chief Directorate Water Ecosystems Management are completed], there is a need for sessions to harvest learnings; a learning platform for articulating project elements that worked well and those that did not; to inform future processes; however, currently such a platform does not exist. Information sessions have been suggested in the past but not taken up due to power dynamics that exist in the activity system (AS1.1-RP10). Role-players found that internally, [within DWS] people tend to interact among themselves on how to execute tasks. Where someone has undertaken a similar activity before, staff share with one another and overcome challenges on peer-to-peer basis (AS1.1-RP10). This would be an example of a learning exchange driven by staff individually and transpiring organically or informally among role-players. These views indicate that a formalised manner in which these learning could be shared would be useful, to encourage learnings among all, and not be dependent on individual initiatives or relationships.*

In terms of organisational learning, the lack of platforms for harvesting learnings is a lost opportunity for identifying and harvesting lessons that could inform future projects and build institutional memory.

5.5 CHANGES IN ORGANISATIONAL PRACTICE ROLE-PLAYERS REGARDED AS EVIDENCE OF LEARNING

Given the study's interest in organisational learning, findings related to role-players' experiences of observed changes over time are highlighted below:

- Adoption of new terminologies, *over time, new terminologies have been adopted that were not in the Regulations 810, examples are Target Ecological Category (TEC) and Recommended Ecological Category (REC) (AS1.1-RP3)*. Adoption of new terminologies can be seen as an example of the organisation grappling to find the most appropriate ways to communicate about the variety of technical processes and procedures that have been put in place, and are from time to time adjusted to execute its complex mandate.
- Integration of RDM projects, whereas in the past the three components of RDM (Classes, Reserve and RQOs) have at times been undertaken separately, they have in the newer studies over the last five years been undertaken concurrently. Role-player AS1.1-RP6 indicated that *integrated projects (Reserve, Classification and RQOs) have provided a platform for learning from each other. There is cross-pollination between these processes now and we are learning from each other, and it has created a platform for communication*. Overlaps in Regulation 810 guidelines steps (see Section 2.3.1.4, Table 2.3 & Appendix 1) have been realised and RDM projects in recent years have integrated to conduct Classification, Reserve and RQOs concurrently. This has been found to be more efficient for compatible approaches, elimination of lag periods for updating information and for cross-pollination of approaches (AS1.1-RP3, AS1.1-RP4, AS1.1-RP6, AS1.1-RP9 & AS1.1-RP10).
- Compared to past RDM projects, the higher confidence levels of projects currently being conducted are a sign of learning, role-players attested to now being able to make decisions that are based on high confidence information (AS1.1-RP9 & AS3.2-RP2).
- *Inclusion of all water resources in projects - a change in this regard is that Dams are now added in [RDM] projects, starting from the Croc-West RDM project onwards (AS1.1-RP3)*.

- *All scientific staff members leading RDM projects and managing bigger projects (such as R20 million budget) [this ensures involvement of all members on a project management level] (AS1.1-RP9 & AS1.1-RP10). The role-player attributed the project budgets as evidence of more responsibility given to Scientists.*
- *Officials in the organisation are nominated for participation in sector specialist meetings, committees, and forums. Officials learn and take their learning [from] these settings and back to [the organisation] (AS1.1-RP9).*
- *Over time a resource pool is being created, former staff members have been able to move even into the consulting space with their knowledge, indirectly facilitating information sharing and resulting in work integrated learning across the sector (AS3.2-RP2).*

5.6 LESSONS FROM PREVIOUS PROJECTS CARRIED FORWARD IN CURRENT PROJECTS

Role-players were conflicted on whether lessons from previous RDM determination projects are being carried forward into future projects. Some indicated that this is not being done. An example is AS1.1-RP7 who noted that *we [DWS] are failing dismally on this part. RDM interpretation and application roadshows for capacitating provincial offices have been undertaken in the past year, however, there are no reflection sessions thereafter to derive learnings or understand the challenges of each region. Provincial offices are not the same and we learn new things with each one visited. The issue is that we focus on urgent current tasks and do not take the time to reflect on the sessions held (AS1.1-RP7).* Another role-player was of the view that: *teamwork is critically needed in order to effectively achieve the common objectives of the job and that the sooner all members involved can own the challenges and transparently reflect on lessons learnt per project; the sooner all members will learn (AS1.1-RP8).*

Other role-players were positive that lessons are being carried forward. AS1.1-RP6 saw evidence of this in that *each operational plan [also known as a business plan] has been informed by lessons from the previous operational plan. Planning for deliverables (such as annual targets) is informed by how things worked in the previous cycle. This has also educated us on how to deal with force majeure events outside our control, such as natural disasters where we can't sample during floods, on how to amend contracts and targets (AS1.1-RP6). Over time*

there has been improvement of outputs formats, inclusion of Dams as part of significant water resources and integration of RDM studies for all Reserve, Classes and RQOs to be undertaken concurrently (AS1.1-RP3).

AS2.1-RP3 provided the following lessons from the Mvoti RDM project:

- *Technical documents post the [RDM] project showing differences to the information gazetted and by that time the consulting teams have exited [meaning that errors sometimes happen and there needs to be a way in which they can be rectified or a misunderstanding of the technical information cleared up].*
- *The [Mvoti RDM] project only produced a high-level implementation plan. The challenge is to take the output of the Mvoti [RDM project] and create a working implementation tool in place, considering elements such as site accessibility that might have changed since the completion of the project. The period between determination and implementation is important; the longer this period, the more aspects might have changed on the ground, e.g. accessibility of sites.*

The same role-player indicated that the lessons below were carried over to the recently completed Thukela RDM project.

- *The exact information about monitoring sites, their locations, coordinates (as examples) and what should be monitored was provided.*
- *It needs to be made clear that the RQOs can't be taken and put as license conditions [because DWS has indicated that RQOs are set for the water resource and not for any individual water user].*
- *Over time the organisational learning is evident in the sense that the Thukela project developed an implementation plan [with specific guidance on what needs to be monitored and where] to guide the Region on focus areas and actions.*

Lastly, AS3.2-RP2 indicated that *we have learnt that gaps exist, but over time there has been improvement. From my participation in other initiatives involving Swaziland and Mozambique, I have seen that other countries are learning from us [South Africa] on how to implement the Reserve.*

5.7 WORKSHOP: IMPLEMENTATION OF RDM IN KWA-ZULU NATAL

In KZN, I co-hosted a workshop with the SANBI uMngeni Ecological Infrastructure Partnership (UEIP) and the DWS KZN provincial office teams, including the proto-CMA personnel. This event arose in the course of the study as a further opportunity to engage with relevant role-players, in this case, those involved with provincial level implementation in case study 2. I co-developed the workshop invitation and programme with the UEIP team (see Figure 5.3 & Table 5.1) so that it could meet both their needs, and allow for focussed data collection relevant to objective 2 of this study. At the same time, the workshop was also useful for broader contextual data collection for the implementation level case.

**WORKSHOP INVITATION:
IMPLEMENTATION OF RESOURCE DIRECTED MEASURES IN
KWAZULU-NATAL**

The South African National Biodiversity Institute's Ecological Infrastructure for Water Security project in collaboration with the Department of Water and Sanitation and Rhodes University will be hosting a workshop that focuses on the implementation of the Resource Directed Measures (RDM) initiatives, to obtain opinions and experiences from key role players in the water sector. The workshop will use social learning approaches such as the Value Creation Framework and Activity Systems tools to surface enablers and challenges as well as the value that may have been derived from the implementation of RDM in KwaZulu-Natal in the past decade.

Objectives:

1. To explore learnings that have taken place over the past ten years of RDM implementation.
2. To investigate how continued development and implementation of RDM (particularly Resource Quality Objectives) at a Water Management Area level can be supported.
3. To identify capacity development needs for Compliance Monitoring and Enforcement regarding RDM implementation as well as the protection and maintenance of ecological infrastructure at national, regional, and WMA levels.

VENUE: TBC, DURBAN DATE: 24 & 25 MAY

Enquiries: Dr Pearl Gola (n.gola@sanbi.org.za) / Ms Kama Meso (mesok@dws.gov.za) / Ms Mmaphefo Thwala (g20t7953@campus.ru.ac.za)



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RESEARCH
COMMISSION**

Figure 5.3: KZN workshop invitation

Table 5.1: Implementation of RDM in KZN – workshop programme

24 May 2023 (Day 1)	
Time	Session
09:00 – 09:30	Registration
09:30 – 10:15	Welcome and Introductions
10:15 – 11:30	Introductory Session: • Background on Resource Directed Measures • KZN RDM Implementation Progress (RO/Proto-CMA) • RQOs Compliance Monitoring Framework
11:30 – 12:00	Tea break
12:00 – 12:15	Exploring learnings from the last ten years of RDM implementation (PhD Study)
12:15 – 12:30	Investigating how continued development and implementation of RDM and CME can be supported (SANBI)
12:30 – 13:30	Group Discussions
13:30 – 14:30	Lunch
14:30 – 15:30	Continuation of Group Discussions Group Discussion Feedback
15:30 – 16:00	Closure of Day 1
25 May 2023 (Day 2)	
Time	Session
09:00 – 09:30	Registration and Welcome Tea
09:30 – 10:00	Recap and Reflection of Day 1
10:00- 10:20	Emerging Themes for Further Discussion
10:20 – 12:30	Consolidation of Workshop Outcomes • What are the issues that have emerged? • What needs to be done to address them? • Roles and responsibilities Conclusion and Way Forward
12:30- 13:00	Reflections using the Value Creation Framework (VCF)
13:00	Closure and Lunch

The workshop was held in Durban, and attended by 25 participants on day one and 17 on day two (see Figure 5.4). The attendees represented local institutions involved in water resource management including SANBI-UEIP, DWS KZN, eThekweni Municipality, uMngeni-uThukela Water, iLembe District Municipality, the Water Research Commission (WRC), the Department of Forestry, Fisheries and the Environment (DFFE) and the Duzi-uMngeni Conservation Trust (DUCT). Participant representation ranged from local government to non-profit, public benefit organisations championing environmental health.

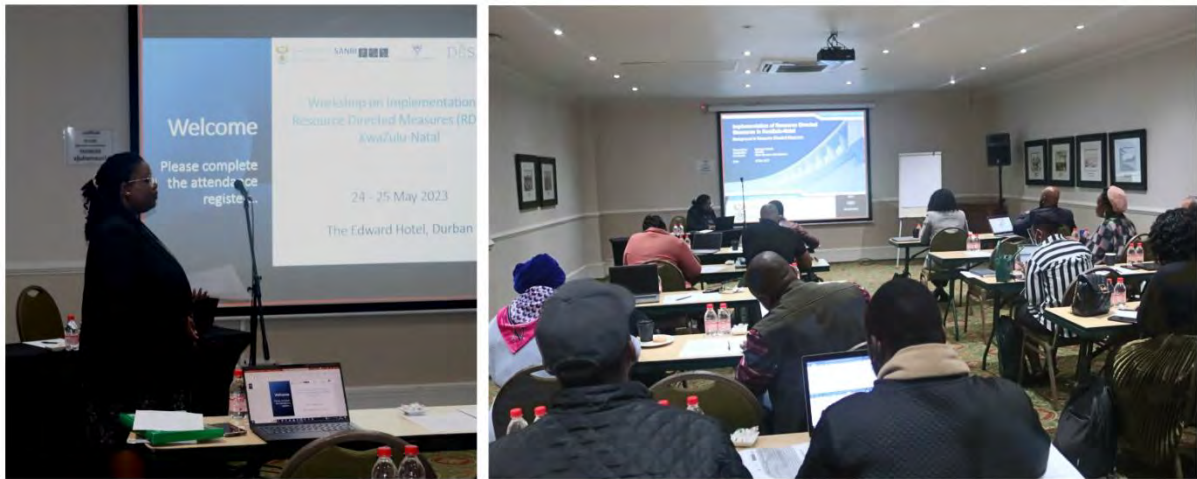


Figure 5.4: Workshop welcome: Implementation of RDM in KZN Province

5.7.1 Workshop process

I introduced my study through a presentation. This was followed by group discussions (see Figure 5.6) through which participants explored the questions in Figure 5.5. Inputs were captured on charts (see Figure 5.7).

Written consent for participation was sought from participants within the study target group, practitioners experienced in RDM, who completed the study forms during the workshop (see Annexure B of Appendix 5). In addition, verbal consent was sought for taking pictures as part of the study data gathering evidence only to be used for academic purposes in this study.



Figure 5.5: KZN workshop role-player engagement questions

Workshop group discussions were held on day 1. Participants were divided into four groups as in figure 5.6. The questions below were provided to all the groups for discussion:

- What was your understanding of RDM?
- What has been your involvement in the determination of RDM?
- What do you think the implementation of RDM entails?
- What do you think your role in implementation should be?
- Why do you think compliance with RQOs is important?

These questions, together with the study specific questions (see Section 1.4 & 3.4.2.2 [e]), were discussed by each group and discussion points were presented with takeaway messages, relative to each question.



Figure 5.6: KZN workshop groups during day 1 discussions

On day 2 of the workshop, I led another session dedicated to the objectives of my study. I presented the activity systems formulated from the document analysis (see Section 3.2 & Chapter 4) and placed them on workshop boards for participants to provide inputs (see Figure 5.7). Inputs for the RDM local implementers and water users activity systems relating to the *instruments, subject, rules, community, division of labour, object* and *outcomes* nodes were written on sticky notes. Participants were given time to place their thoughts relative to each activity system node on the board.



Figure 5.7: KZN workshop activity system inputs

I then led the workshop discussion to reflect on the group discussions from the day before, and to consolidate the outcomes of the workshop. The consolidation of workshop outcomes aimed to answer:

- What are the issues that have emerged?
- What needs to be done to address them?
- What are the roles and responsibilities?

Individual groups finalised their group discussion notes. Thereafter, participants reflected on all the group charts and engaged in further discussions, as in Figure 5.8.



Figure 5.8: KZN workshop day 2 group consolidation of discussions

5.7.2 Workshop data points

All workshop participants discussed the themes that emerged through presentations and individual group discussions, throughout the workshop (see Figure 5.8). Table 5.2 provides a summary of the data points that were formulated through the workshop.

Table 5.2: KZN workshop data points

Category	Workshop Data Points
Roles and Responsibilities	<i>Lack of clarity about roles and responsibilities among role-players, leading to a lack of RDM implementation action.</i>
What constitutes implementation?	<i>Various [as above] local institutions on the ground are undertaking initiatives and programmes that contribute towards RDM implementation, some without naming it as such. Others have consciously resorted to doing so in the absence of a CMA to ensure work proceeds, to curb further degradation of the environment and water resources, while waiting for the establishment of a CMA For example, eThekweni Municipality runs various initiatives, they conduct work in water resources, using practical measures, such as municipal and area specific plans, integrating them to focus on alien invasive species clearing, restoration and park clean-ups, in partnerships with other institutions, such as Enviro-Champs and SANBI programmes.</i>
Lack of Integration of efforts	<i>The role of local government needs to be included / considered / incorporated in RDM implementation initiatives.</i> <i>We are not connected, yet we are doing the same thing and aiming towards the same goals.</i> <i>Silos exist within different units of same institutions and across – everyone sticking to their own mandates. There is lack of linkage among all the institutions.</i> <i>A variety of stakeholders are undertaking different initiatives; these efforts are dispersed due to lack of coordination, collaboration and communication, hence failing to have greater impact, and sometimes there may also be duplication.</i> <i>Examples of lack of integration:</i>

Category	Workshop Data Points
	• <i>Currently, several processes that have an impact on each other are underway concurrently, for example the National Water Resource Strategy 3, Amendment Bill, Water Pricing Strategy.</i> • <i>Alignment efforts are needed, such as using existing monitoring points, and existing monitoring programmes, for example, water quality monitoring is underway in various institutions.</i>
RDM Outputs Actions Needed	• <i>Collaboration is needed to ensure clear understanding of RDM outputs.</i> • <i>RDM outputs need to be translated into practical, measurable, implementable actions.</i> • <i>A process is needed for translating RDM outputs to achievable, implementable plans on the ground.</i> • <i>Gazetted variables/parameters need to be monitored.</i>
Knowledge sharing and awareness	• <i>The national departments, DFFE and DWS must establish forums and involve all relevant stakeholders, there is a need for establishment of collaborative platforms for information dissemination purposes.</i> • <i>DWS, forums are in place, the issue is ensuring active participation of community and local government counterparts.</i>
Towards Implementation	• <i>Implementation of RDM outputs has been incorporated in the draft CMS, this will ensure that activities are included in action programmes and resourced (human, budget and time) and that outcomes are reported back to stakeholders to ensure they understand the status of their catchments and also to bring confidence in the Department.</i>
Need for platforms/spaces for raising regional concerns	• <i>A platform /space is needed for regional concerns to be raised, for example, DFFE has a municipal support structure, and a similar structure is needed for DWS.</i>

The workshop provided a valuable synthesis of the views from a variety of role-players from a range of water sector institutions, including and beyond DWS.

5.8 ROLE-PLAYER ENGAGEMENT SYMPOSIUM ON CAPACITY BUILDING

The Centre for Water and Environment at the Independent Institute of Education (IIE), commonly known as Monash South Africa (MSA), invited me to participate in a sectoral symposium on 9 and 10 November 2023 (see Figure 5.9 and 5.10). I was asked to share the interim findings of my study and to deliver a related presentation on capacity building. This symposium provided me with an opportunity to focus on capacity building as one of the major emerging themes in the study.

In preparation for the symposium, I deepened my research on capacity building and requested additional interviews with relevant role-players within DWS. The relevant data points from this additional research are listed under AS1.1-RP11 in Appendix 9.



Dear Sir/Madam

The Centre for Water and the Environment at the IIE MSA aims to adequately respond to emerging challenges facing Africa's water security through both research and teaching to improve capacity for water management in Africa.

As part of this, the Centre, in conjunction with the Research and Postgraduate Studies Unit, is holding its second annual Water Symposium.

It is with great pleasure, that we would like to invite you to attend the Symposium:

Date: 9 & 10 November 2023 | Time: 08h00 - 16h00 | Venue: IIE MSA, 144 Peter Road, Ruimsig

In line with the theme "Bridging the Gap - Water Security, Climate Change and Resilience in the 21st Century", a key focus of this Symposium will be on mechanisms to 'bridge the gap' between researchers, students, government and practitioners. In order to do this, the programme features six main sessions which will interrogate current research and policy but also include discussions and themed breakaways that deal with practice, education and capacity building. Participants in the Symposium span a range of sectors which will add richness to the discussions. The symposium will have three main aims:

- Networking and Sharing of Knowledge;
- Student Development and Community Building;
- Powering the discourse between researchers, educators, students and practitioners with the aim of bridging the so called "implementation gap".

A full programme will be sent out to all presenters and delegates in due course.

Figure 5.9: IIE MSA symposium invitation

9 November 2023

Lecture Theatre 5



Time	Session	Activity	Lead/Participants	Organisation
08h00 to 09h00	Arrival, Registration and Tea			
09h00 to 09h15	Opening and Welcome	Welcoming Remarks	Andre Lubbe	IIE MSA
09h15 to 09h25		Opening Remarks	Dr. Willy Engelbrecht	IIE
09h30 to 10h00	Session 1 – Contextualising Water Security and Climate Change	Key Note Address 1 Regional Water Security and Climate Change	Prof. Mbangi Nepfumboda	University of Johannesburg
10h05 to 10h25		Presentation 1 – Climate Change and Water Security Perspective for Gauteng City Region	Gillian Maree	Gauteng City Region Observatory
10h30 to 10h50		Presentation 2 – Understanding Water Security at Local Government level	Prof. Richard Meissner	UNISA
10h50 to 11h15	Tea			
11h20 to 11h40	Session 2 – Building Capacity to ensure Water Security	3 Minute Thesis Competition	Student Entries	IIE MSA
11h40 to 11h50		Research Associate Opportunities	Dr. Rika Swanzen	IIE MSA
11h50 to 12h00		3 Minute Thesis Competition Award Ceremony	Margi Boosey	IIE
12h05 to 12h25		Presentation 3 – Capacity Building in DWS	Mmaphefo Thwala	Department of Water and Sanitation
12h30 to 12h50		Presentation 4 – Bridging the gap between research, policy and implementation	John Dini	Water Research Commission
12h55 to 13h15		Presentation 5 – Role of Higher Education	Linda Downsborough	IIE MSA
13h15 to 14h15	Lunch			
14h30 to 15h30	Session 3 – Bridging the Gap – Capacity Building in the Water Sector	Themed Breakaway 1	Mmaphefo Thwala	Department of Water and Sanitation
		Themed Breakaway 2	Linda Downsborough	IIE MSA
		Themed Breakaway 3	John Dini	Water Research Commission
15h30 to 15h45	Tea			
15h45 to 16h15	Session 3 – Bridging the Gap – Capacity Building in the Water Sector (continued)	Panel Discussion/Feedback Session	Mmaphefo Thwala Linda Downsborough John Dini	DWS IIE MSA WRC
16h15 to 16h30		Day 1- Closing Remarks	Linda Downsborough	IIE MSA

Figure 5.10: IIE MSA symposium programme

The two-day symposium was attended by approximately 29 participants each day. The attendees represented local institutions including SANBI, DWS, University of the Free State (UFS), City of Tshwane, Wildlife and Environment Society of Southern Africa (WESSA), Rand Water, Gauteng City Region Observatory (GCRO), WRC, Eskom, Steve Tshwete Local Municipality, Lekwa Local Municipality, Exxaro mining company], Esibayeni Group, Johannesburg Water, QWC Consulting and Capricorn District Municipality. The participant representation ranged from national departments, local government entities, water boards and academic institutions (see Figure 5.11).



Figure 5.11: My presentation at IIE MSA symposium and participants

On Day 1 I gave a presentation focusing on the capacity building component of the study. I also had an opportunity to facilitate a follow-up, parallel breakaway session titled *Capacity Building in the Water Sector* (see Figure 5.12). To create meaningful engagement, and potentially gather useful data for objective 2 of my study, the questions guiding stakeholder engagement around capacity building were:

- What has been done before? (status quo/current practice)
- What are the challenges – what does not work with the status quo?
- What does work or what is done well?
- Where do we want to go – what is the vision?
- How do we get there – what are the practical and actionable steps we can take?



Figure 5.12: IIE MSA breakaway session focussed on capacity building

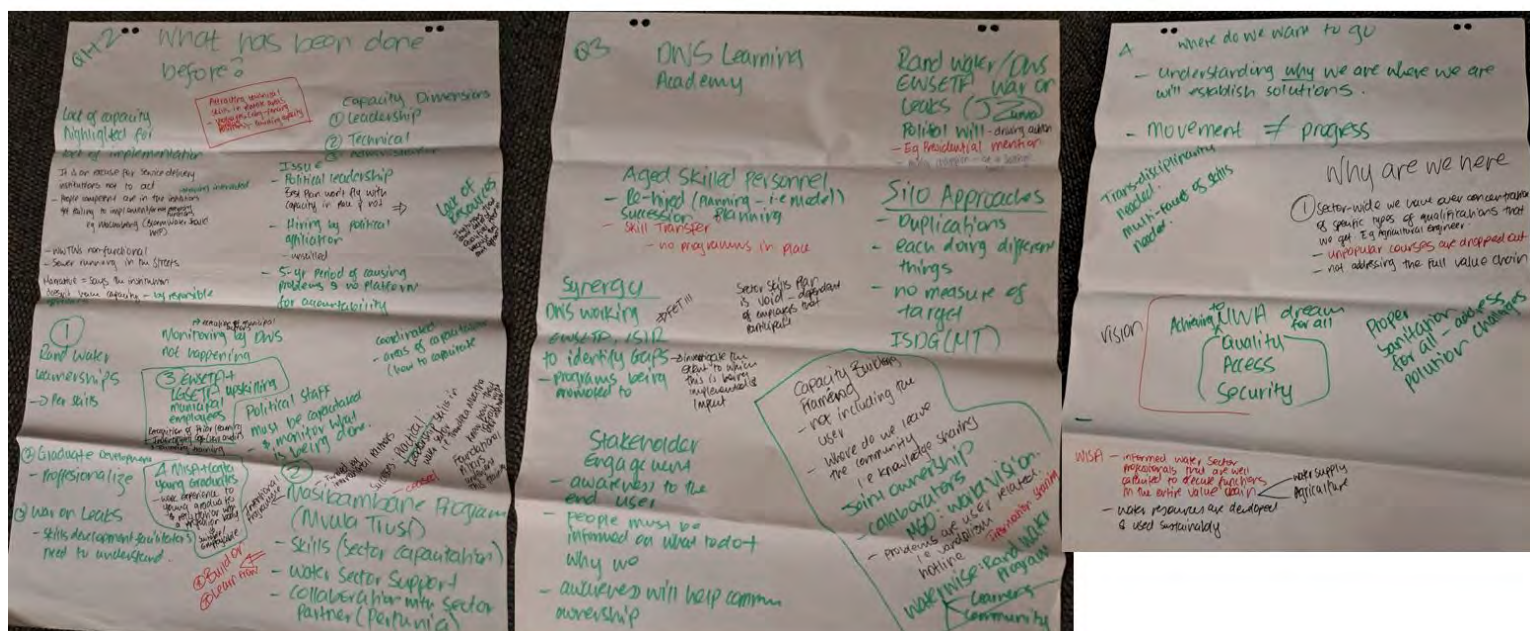


Figure 5.13: Discussion charts from the IIE MSA breakaway session on capacity building

5.8.2 Symposium data points

Table 5.4 provides a summary of the data points that were captured from the group discussion.

Table 5.3: Capacity building breakaway session data points

Discussion Question	Workshop Discussion Points
Status quo/current practice (what has been done before?)	• <i>Various programmes have been put in place for skills development in the sector, including:</i> - <i>DWS graduate trainee programme</i> - <i>Rand Water learnerships</i> - <i>War on Leaks youth on-the-job training programme</i> - <i>Rand Water graduate development programmes</i> - <i>Masibambane Programme (Mvula Trust) – historically offered technical skills and sector support, it was an intentional, coordinated, funded capacity building programme that we should build on and learn from it.</i> • <i>Energy and Water Sector Education and Training Authority (EWSETA) and Local Government Sector Education and Training Authority (LGSETA) upskilling municipal employees.</i> • <i>Municipal Infrastructure Support Agent (MISA) and Department of Co-operative Governance and Traditional Affairs (COGTA) young graduates work experience on the job training and registration with a professional body. Graduates exit the programme with suitable and employable status.</i>
What are the challenges? What doesn't work with the status quo?	• <i>Lack of capacity highlighted as a reason, among others, for the lack of implementation.</i> • <i>Lack of political leadership or political will – sometimes there is competent staff but without the political will, projects and plans won't be implemented.</i> • <i>The 5-year political cycle results in changes in the political leadership over a fairly short period of time which then sometimes also results in a lack of accountability.</i> • <i>Lack of resources – sometimes institutions cannot attract qualified people as they cannot offer them competitive salaries, particularly when the positions are also in remote rural areas. In these instances a capacity building plan where an institution builds its own capacity by fostering (educating) local talent has been witnessed to work in the past.</i> • <i>Non-functional waste water treatment works (WWTWs) polluting water resources and posing health risks to communities, and monitoring execution of municipal actions, responsible for these WWTWs, is not happening.</i> • <i>Ineffective succession planning in DWS where aged skilled personnel are getting re-hired into technical position because skills transfer hasn't taken place.</i>

Discussion Question	Workshop Discussion Points
	• <i>The silo approach issue – many programmes are implemented by various institutions and sometimes there are duplications, a point also mentioned at the KZN workshop.</i> • <i>Lack of monitoring targets for skills development resulting in lack of knowledge for further capacity building planning. How do we know we have trained enough people?</i> • <i>Sector priority skills list, developed annually by SETAs, are problematic and lack participation by key institutions in compiling these lists, leading to a list that is not a reflection of what is needed.</i> • <i>A limited framing of capacity building does not include the user and communities. Initiatives and projects are put in place but there is no stakeholder awareness of what institutions are trying to do. For example, there will be a War on Leaks project but the moment the project ends, there is vandalism and there are new leaks and people do not know who to call to address these issues. So, stakeholder engagement, awareness to the end user and information for the people are key so that people can ultimately take ownership of whatever you put in place, look after it and where there is a need for calling for help, they know where to call.</i>
What is working well?	• <i>In some programmes the participating institutions have achieved synergy, e.g. the WRC, DWS and Council for Scientific and Industrial Research (CSIR) in the Framework Programme for Research, Education and Training in the water sector (FET Water III programme).</i>
Where do we want to go – what is the vision? How do we get there – what are the practical and actionable steps we can take?	• <i>In order to know where we want to go, it's important to understand why we are where we are so that we can establish solutions and a way forward. In particular, 'movement does not necessarily equal progress'.</i> • <i>The group highlighted the need for transdisciplinarity, saying that multi-faceted set of skills are needed. Currently, there is an over concentration of certain kinds of qualifications that are feeding into the sector. Whereas no attention is paid to certain other qualifications and thus results in the qualifications being dropped by universities. This is problematic because the skills and qualification are not for the full value chain of the water business.</i> • <i>The group noted that the dream or overall vision is good quality water for all and ultimately water security. In addition, the need for proper sanitation so that pollution challenges can be addressed. An example of a good vision is WISA's one: informed water sector professionals that are well capacitated to execute functions in the entire value chain.</i>

I also had an opportunity to participate in a breakaway session titled *Creating awareness through environmental education and civil society*, facilitated by Mr Quinex Chiluwe (see Figure 5.14), which also raised points relevant to objective 2 (see Section 1.4) of my study. These perspectives are included here, although not part of the original research plan.

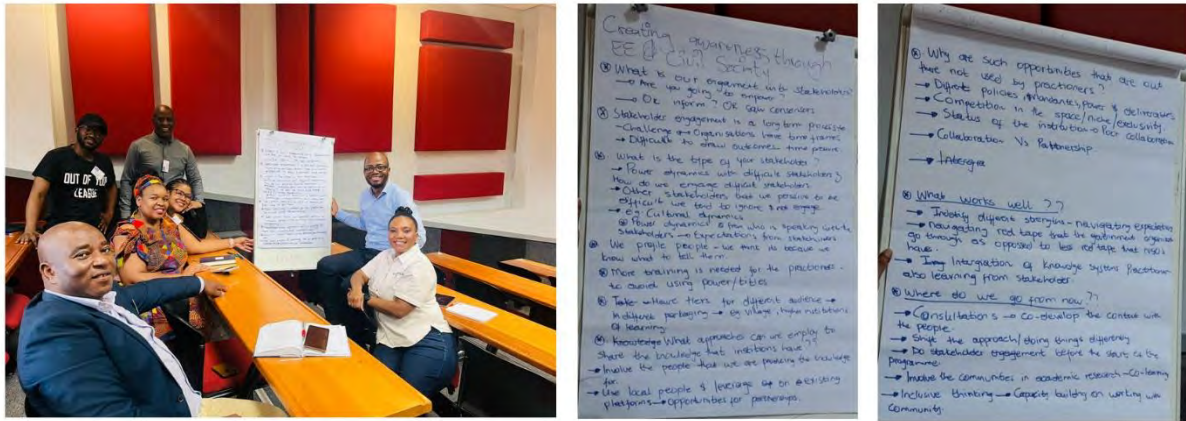


Figure 5.14: IIE MSA breakaway session on creating awareness and discussion chart

The group discussed, *what is awareness and what is the community?* The following key considerations were raised, as captured in Figure 5.14:

- *The community can be people who benefit from things or actions, or they can be people who make decisions.*
- *Empowering people is a long-term process and takes a lot of sustained effort.*
- *Projects [such as RDM projects] run according to [short term] timeframes and there isn't always time to do everything such as empowerment within the time frames of such projects.*
- *Designing an approach to empowerment depends on the stakeholders and the context, there is not a one size fits all [approach]. There is a need to profile the stakeholders and know them so that one is better able to target them.*
- *Sometimes we need capacity and sometimes we need training – academics are not always the best or most appropriate facilitators, and community members can also play this role.*
- *There is a need for embedded research, within community, action research and transdisciplinary research.*

5.9 ROLE-PLAYER ENGAGEMENTS FINDINGS

The findings on role-player experiences were derived from the multiple engagements detailed in this chapter and analysed within each segment (grouping per question). An analytic memo (see Table 5.4) was compiled to consolidate the findings of role-player experiences across all data points. Summarising them in this tabular form allows for cross-comparison of factors.

Table 5.4: Summary of findings from role-player engagements during Phase 2

RDM Determination	RDM Implementation
Roles and responsibilities	
Integration of roles and responsibilities between RDM staff members and consulting team members is needed to ensure skills transfer and capacity building.	- Lack of clarity about roles and responsibilities among role-players leads to a lack of RDM implementation. - It should be clear who will do what between the Provincial Office and the CMA.
Lack of integration of efforts	
- A variety of stakeholders are undertaking a variety of different initiatives. These efforts are dispersed due to a lack of coordination, collaboration and communication, hence failing to have greater impact, sometimes there may also be duplication. - An example given at the time, in May 2023, several development processes that had an impact on each other were underway concurrently, such as examples the National Water Resource Strategy 3, the Amendment Bill, the Water Pricing Strategy. - Another integration issue is that if Classes, Reserve and RQO projects are conducted separately, in some instances, inefficiency	- Various local institutions on the ground at catchment level are undertaking different initiatives and programmes that contribute to RDM implementation. Alignment of these efforts are needed, such as using existing monitoring points and existing monitoring programmes for consolidation of monitoring data, for example, water quality monitoring is underway in various local institutions. - partnerships and cooperative governance to integrate efforts, share data and avoid duplication of efforts.

RDM Determination	RDM Implementation
occurs to update components years later when the full process is being conducted.	
Stakeholder engagement and involvement	
• Co-develop of RDM - tools need to be developed with stakeholders on the ground who need to take them forward into implementation to minimise challenges. • The top to bottom approach is not working, NGOs on the ground should be equipped to assist people to participate meaningfully. • Community stakeholder groups should be involved, and consideration should be given to accessibility of information in terms of scientific language compared to indigenous language.	
Communication of RDM outputs	
• Communicate far and wide, not limited to committee meetings, project engagements and DWS website. • Identify implementing officials and ensure handover of outputs for implementation, and facilitate a dedicated engagement process, including an explanation of the technical content, to limit misinterpretations of outputs. • Protection of water resources needs to involve people at a local level to facilitate awareness and curb pollution at source. • Given the technical nature of RDM project information, communication approaches need to be differentiated per group of stakeholders. • Higher confidence levels of RDM projects currently being conducted are a sign of learning over time.	
RDM implementation considerations	
• Implementation actions should be spelled out and factors involved should not be assumed. The National Office needs to own the full process by making provision of implementation guidance by providing the following: - A procedure to indicate how to utilise RDM outputs; - A practical guide on how the RDM outputs should be translated into an implementation plan, specifying, who will conduct monitoring, what indicators should	• It is not clear where the provincial office implementation mandate is specified. • Provincial offices are waiting for implementation plans or business processes on how RDM implementation should be conducted. • Enablers for implementation action include: - Implementation of RDM outputs has been incorporated in the draft catchment management strategy (CMS). This will ensure that activities are included in action programmes and resourced (human, budget

RDM Determination	RDM Implementation
be monitored and establish whether resources are in place to take samples, analyse them, as examples. • Role-players were not clear on what constitutes implementation. This stems from the fact that the end point of the RDM process are RQOs which are narrative and numerical specifications of the quality and quantity of water that needs to be met in water resources, and to ensure adherence to them involves various catchment management processes. • Caution was made that there is a big difference between implementation and monitoring and that the two tend to be confused, indicating that biomonitoring is not necessarily RDM implementation. Implementation involves both monitoring to identify the status of the water resource and where unacceptable, taking decisions to manage the resource.	and time) and that outcomes are reported back to stakeholders to ensure that they understand the status of catchments and also to bring(stimulate) confidence in the Department. • Adaptive Resource Management - An example was made referring to rehabilitation interventions that have been put in place in a number of wetlands at catchment level in the Working for Wetlands programme, working alongside SANParks to manage wetlands. Where interventions were not working, new approaches were adopted. • Beyond all protection measures recommended, on the ground protection of water resources is needed, working with all stakeholders, including communities).
Transition to implementation involves various aspects These including: • clarification of roles and responsibilities on exactly who must do what; • resource allocation, in terms of time, budget and staff; • collaboration to ensure clear understanding of RDM outputs; • translation of RDM outputs into practical, measurable, implementable actions; • processes are needed for translating RDM outputs to achievable, implementable plans on the ground; • gazetted variables or parameters need to be monitored.	
RDM implementation needs • Functional technical tools include: - working tools, such as computers, models; - decision support tools; and	

RDM Determination	RDM Implementation
- real-time monitoring systems. • Budget provisions. • Availability of suitably qualified and experienced human resources. • Need for platforms and spaces for raising catchment level concerns, for example DFFE has a municipal support structure, and a similar structure is needed for DWS. • Incorporation of RDM outputs into key implementation tools such as the DWS reconciliation studies, CMSs and IDP, which are municipal planning tools, and this way RDM can be allocated implementation resources and considered in catchment action plans. • Establishment of implementing institutions, such as proto-CMAs that need to be fully established for decision-making purposes, facilitating actions at catchment level, and to shorten the reporting line.	
RDM outputs actions needed	
• Knowledge sharing and awareness. • Fragmentation in the reporting processes, institutionally, for example, there is a challenge with the multitude of requests from the National Office to Provincial Offices, often times needing minor tweaks in format on information already provided. Regional officials are already overloaded with work on the ground and under-resourced, in terms of staff, budget and time.	• The national departments of DFFE and DWS must establish forums that involve all relevant stakeholders. There is a need for collaborative platforms for information dissemination. In DWS there are forums in place. The issue is ensuring active participation of community and local government stakeholders. • The importance of community education and knowledge transfer which can result in closing the gap between scientists and communities.
Standardisation	
• Each consultant team's outputs are in a different format. This is due to varied interpretations of the Regulations 810 (South Africa. DWA, 2010) guidelines, and consequently different approaches in projects. • The need for standardisation on the presentation of information in gazettes and on the approach of RDM determination was echoed by the majority of stakeholders, with role-player AS1.1-RP8 arguing that regardless of which tools are used, the outcomes must respond to the intended objectives.	
Capacity building	
• Skills development needs to consider existing capacity and address identified gaps. • Empowering people is a long-term process and takes sustained effort. • RDM projects run according to short term timeframes, of between two and three years, and there isn't always time and budget to conduct comprehensive skills transfer.	

RDM Determination	RDM Implementation
Learning • Learning in the organisation (DWS) is taking place and should be carried forward through revisions in operational business plans each year, based on practical experiences of the previous cycle. • The organisation has learned that there is a need for a review period of RDM outputs to provide a platform for rectifying errors, where necessary. • Integration of projects where Classes, Reserve and RQOs are conducted concurrently were viewed as a sign of learning about the efficiency of integration of the three components of RDM. • Inclusion of dams as part of significant water resources in projects.	
Need for learning platforms • Platforms for learning, post RDM projects, were not evident which presented the following: - no means for harvesting process related matters that worked well and those that did not; and - lost opportunities for explicitly identifying lessons learnt.	

5.10 CONCLUSION

This chapter presented role-player experiences generated through:

- engagements, following a presentation of the study objectives at the National Wetland Indaba (NWI) in October 2022;
- semi-structured interviews conducted over the period of February to December 2023, either in-person in the workplace or online;
- engagements following a presentation on the study during the KZN RDM implementation workshop, co-organised with SANBI;
- engagements following a presentation focussed on capacity building during an IIE MSA symposium; and
- follow-up discussions with role-players, after interviews.

In all cases, I used Phase 1 findings as mirror data to stimulate role-player inputs, reflecting on learning, practitioner knowledge and experiences.

In line with Danemark et al. (2002), the data was organised according to emerging themes, and extensive use was made of quotations. It should be clear that role-players were generally very forthcoming and eager to share experiences in the determination and implementation of RDM, or lack thereof, and associated challenges and learnings. The data is rich, often very detailed, and covers a vast scope of factors. Role-players also made recommendations related to emerging themes. These were considered alongside my other findings emerging from applying the analytical frameworks described (see Section 3.5), to derive ultimate recommendations from the study. To make sense of the data, and search for deeper insight, the data will be subjected in Chapter 6 to two analytic tools, an activity systems analysis, and contradiction analysis, as introduced in Chapter 3, Section 3.5.

6. CHAPTER SIX: MAPPING ACTIVITY SYSTEMS AND CONTRADICTION ANALYSIS

6.1 INTRODUCTION

The study deployed the second generation of Cultural Historical Activity Theory (CHAT, Leont'ev, 1978; Engeström, 1987; Daniels, 2008; Engeström & Sannino, 2010) framework to view the practice of Resource Directed Measures (RDM) as an activity system. Based on the findings introduced and discussed in Chapters 4 and 5, it intended to offer exploratory depth on these factors, and explanations of what role-players do, why and how, in pursuit of water resource protection, the *object* and *outcome* of RDM activity. The aim of this exploration is to understand these factors in new ways that could contribute to organisational learning for future RDM processes, in DWS where I work, and in response to the second research Question: *What learning is evident from the experiences of role-players in the implementation of water ecosystem management through RDM?*

In Section 6.3, CHAT is applied to the findings surfaced in Chapter 4, to map the activity systems in the chosen case study contexts. This included mapping the associated *instruments* or *tools*, *subjects*, *rules*, *community*, *division of labour*, *object*, and *outcome* in case study 1, the national office (see Section 6.3.1) and in the provincial case studies 2 and 3 (see Sections 6.3.2). In Section 6.4, CHAT is applied to the findings surfaced in Chapter 5 to analyse manifestations of contradictions observed in the mapped activity systems, as potential growth buds for further learning and change. Lastly, in Section 6.5, I summarise the main findings, concluding with reference to emerging sub-activity systems. Using the main elements of the CHAT framework, Chapter 7 will provide a deeper discussion towards synthesis of the study findings and recommendations.

6.2 ACTIVITY SYSTEM ANALYTIC TOOL

As briefly introduced in Section 2.3.3 and illustrated in Figure 2.2, an activity system consists of interacting, historically and culturally emergent *tools*, *subjects*, *rules*, *community*, *division of labour*, *object* and *outcomes* which I call 'nodes'. An activity system as the unit of analysis in CHAT presents the overarching *object* of RDM determination for water ecosystems

protection, interacting with associated *tools*, role-players or *subjects*, *rules*, *community* and *division of labour* (Engeström & Sannino, 2010).

The activity is an object-oriented, culturally and materially mediated system, with *division of labour* for knowledge and *rules* that regulate interactions between the participating individuals (Cole and Engeström, 1993). Of central importance to this study is the focus on a collective, *object*-oriented activity within this system.

6.2.1 Activity system mapping approach

During Phase 1 and based on the process of document analysis, preliminary activity systems were mapped in the three case studies. This document analysis provided contextual and historical information on the activity systems, as well as insights from past initiatives. Documents such as the Issues and Response Registers (IRRs) served as artifacts surfacing the voices of role-players involved in or commenting on various past RDM initiatives.

In Phase 1, I adapted and used a framework from Uden (2007) to help me map and describe activity systems in the case studies (see Table 6.1). The guiding questions in columns one and two (see Table 6.1), outlined in this framework, aided the mapping of the case studies' activity systems, drawing on insights from the document analysis (see Chapter 4). Answering these questions assisted me in mapping data for each component of the activity systems in terms of *subjects*, *tools*, *object*, *division of labour*, *community* and *rules*. A high-level overview of the analysis is provided in columns three and four of Table 6.1.

To surface the voices of role-players about their insights and learnings (see Chapter 5), activity systems mapped during Phase 1 were presented to role-players during semi-structure interviews in Phase 2. Through these interviews they confirmed and expanded on information in the activity systems. Role-player inputs on activity systems are captured in Appendix 6 and mapped into activity systems in Section 6.4.

Table 6.1: Activity system mapping tool and analysis per activity system

Source: Adapted from Uden (2007, pp. 94-95)

Activity System Components	Questions to identify and describe activity systems	National Office RDM determination activity system	Provincial and CMA RDM implementation activity systems
Object	What is the objective of the activity?	- RDM (Classes, Reserve and RQOs) determination: - outputs documented in project reports and published in the government Gazette; - information accessible on the RDM website.	- Catchment water resource management alongside implementation of RDM outputs: - consideration of RDM in water use authorisations and water use license conditions; - Compliance monitoring.
Outcome	What is the outcome of the activity?	- Water resource protection. - Sustainable water ecosystem management, balancing between use and protection.	Sustainable catchment water resource management.
Subject	Who are the people engaging in the activity system? What roles do they play?	- Project managers administering the project. - Consultants conducting technical work. - Committee members, including project management and steering committee members (PMC and PSC), respectively.	Water resource practitioners at provincial offices and CMAs, such as catchment managers, control environmental officers and project managers, working) at catchment level.
Instruments/ tools	What <i>tools</i> are used in this activity? Are they available to role-players?	The work is mandated by: - Chapter 3 of the National Water Act 36 of 1998 (NWA); - Regulations 810 steps, prescribing the process to be followed; and	- Gazetted RDM outputs, including Classes, Reserve and RQOs. - NWA - NWRS and NW&MP

Activity System Components	Questions to identify and describe activity systems	National Office RDM determination activity system	Provincial and CMA RDM implementation activity systems
	What are the physical <i>tools</i> used to perform the activity? What are the psychological <i>tools</i> such as methods, procedures, techniques, languages, among others, used? How have the <i>tools</i> changed over time?	- Applicable policies and strategies, including the National Water Resources Strategies (NWRS) 1, 2, 3 and the NW&SMP. For execution, the work needs: - models; and - data input from monitoring programmes.	
Rules	What are the <i>rules</i>, formal and informal, that guide the activities role-players are engaged in?	- Regulations 810 steps prescribe the process to be followed. - Process must be stakeholder driven through: - meetings of the PSC, PMC and public meetings); - technical workshops; - stakeholder consultations.	Stakeholder engagement at Catchment Management Forums (CMF) and provincial committee meetings.
		- Capacity building and skills transfer are a pre-requisite in project terms of reference. 60-day public comment period for stakeholder comments.	
Community	Who are the <i>community</i> members and what is the structure of social interaction	- Department of Water and Sanitation staff members in the <i>subject</i> node; - Consultant team members; and	All water users, including domestic, industrial, agricultural water users, sector organisations, local municipalities as examples.

Activity System Components	Questions to identify and describe activity systems	National Office RDM determination activity system	Provincial and CMA RDM implementation activity systems
	surrounding the activity?	All community members comprising of interested and affected internal and external stakeholder groups.	
		Role-players interact through project meeting platforms such as Project Management and Project Steering Committees.	
Division of Labour	Who have traditionally taken on the different roles? How does this affect work/group activities or breakdowns? How do these roles relate to others? What is the <i>division of labour</i> within the activity system?	- Different consultant teams have undertaken the technical work differently across catchments and in different portions, that is Classes, Reserve and RQOs separately or integrated. - RDM Project Managers - Officials administrating the projects. - The PMC - individuals from the CD: WEM, other DWS directorates, DWS Provincial office directorates, CMAs and the consultant team. - The PSC - comprised of members from various sectors providing strategic guidance and reporting functions to their interested sectors. - Provincial offices mandated with implementation of outcomes.	Water resource practitioners at provincial offices and CMAs, including catchment managers, control environmental officers and project managers at catchment level.

6.3 MAPPING AND DESCRIPTION OF STUDY ACTIVITY SYSTEMS

Section 6.3.1 and 6.3.2 below illustrate and describe the activity systems in the selected case studies. I present and describe each activity system in its initial form, as it was mapped in Phase 1. Thereafter the activity systems with role-player inputs are provided. This illustrates the inputs, feedback and insights that role-players provided and shows how they enhanced each activity system. This is followed by a contradiction analysis for each activity system using phase 2 data from role-player engagements, shared in Chapter 5.

6.3.1 Case study 1 selected activity system

6.3.1.1 National Office RDM determination activity system mapping

Case study 1 is the overarching case, located in the National Office of the DWS, the organisation responsible for RDM. As an activity system, it consists of role-players in the DWS National Office (see Table 3.3) mandated with water ecosystem management, through determination of RDM for water resource protection, specifically the determination of Water Resource Classes, the Reserve and RQOs. They include those involved in RDM determination for the selected catchment case studies 2 and 3. I named this activity system the National Office RDM determination activity system. It was initially mapped in Phase 1 (see Figure 6.1) using insights from the document analysis, and shared with role-players in Phase 2 for comments. In Phase 1, pre-liminary contradictions (see Section 3.5.3) were pre-empted using document analysis data. These were further developed and expanded and are explained in Section 6.4.

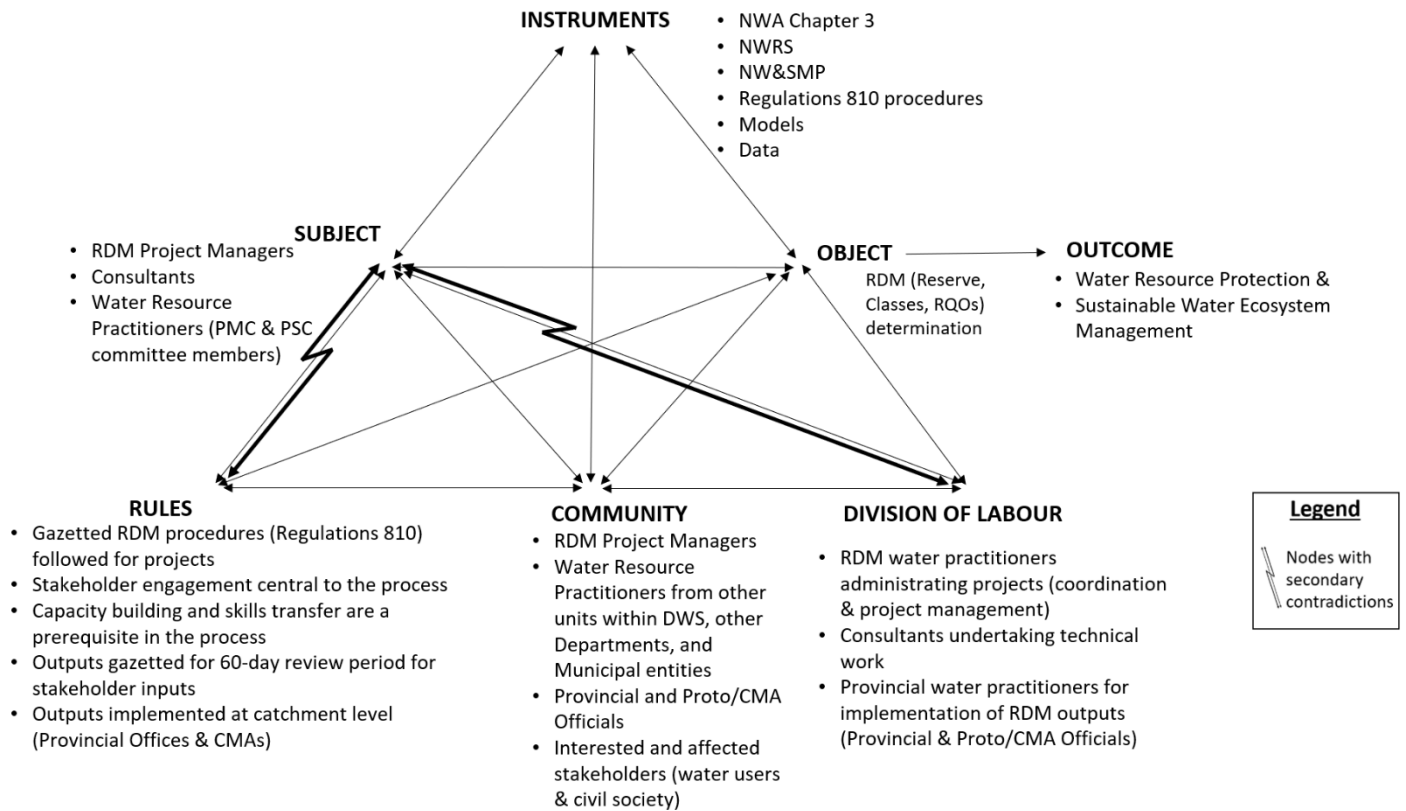


Figure 6.1: National Office RDM determination activity system

Source: Author

6.3.1.2 National Office RDM determination activity system description

In the National Office RDM determination activity system (see Figure 6.1), the *subjects* or role-players are the RDM project managers, consultant teams and water resource practitioners from other DWS divisions. RDM project managers are government staff in the national head office of the DWS. The consultant teams comprise of a variety of scientists, such as hydrology, water quality, vegetation, ecology, socio-economics and geomorphology specialists, among others, hired to conduct technical specialist work as professional service providers. The other water resource practitioners are those who work outside of the RDM activity system, participating in the RDM project, for example, through project committee structures.

The intended *outcome* of the activity is water resource protection, through the *object* of RDM determination, consisting of setting or determining the Water Resource Classes, Reserve and Resource Quality Objectives (RQOs). All of these serve as resource protection *tools* in the RDM

implementation phase. In the determination of RDM, *instruments* include the National Water Act 36 of 1998 (hereafter the NWA; South Africa, 1998), the three iterations of National Water Resource Strategies (NWRS), the National Water and Sanitation Master Plan (NW&SMP), Regulation 810 procedures that provides step-wise guidance on RDM determination, and associated input data and models utilised. Each component of the activity system has historical elements, as an example, the different models that have changed over time and different consultant teams using these varied models.

The *rules* include those guided by Regulations 810, specifying steps to be followed in RDM determination, including also processes of stakeholder engagement. Along with these Regulations 810, specification detained in project terms of references (ToRs) for consultants and project inception reports also shape these *rules*. The ToRs include a capacity building requirement for skills transfer between consultants and DWS officials during the RDM project. Undertaking stakeholder engagement is a key requirement in RDM projects, as well as a 60-day review period prior to gazetting RDM outputs, which are ultimately implemented at provincial office and catchment management agency (CMA) level.

The RDM project team, that is DWS project managers, consulting teams and committee members are involved in the *division of labour* in executing the *object* of the activity. The roles of these *subjects* differ as per the project task teams in each project. Historically, the project management and project steering committee structures have been platforms where DWS provincial office and CMA representatives participate in the activity. These *subjects* extend to the *community* which includes also interested and affected parties, comprised of water users on the ground in the catchment, civil society and those community members who are included in the project through the project steering committee.

6.3.2 Case study 2 and 3 selected activity systems

6.3.2.1 Provincial Office and CMA RDM implementation activity systems mapping

Case studies 2 and 3 consist of role-players, or *subjects*, in the provincial and CMA offices mandated with catchment level water resource management, including implementation of RDM outputs. They have been involved in various RDM determination and implementation efforts in the last 10 years and more. In Phase 1, this activity system was mapped as depicted in Figure 6.2 based on the document analysis. In Phase 2 it was shared with role-players in KwaZulu-Natal (KZN) and Mpumalanga, who added to it based on their context, as discussed in Sections 6.4.2 and 6.4.3.

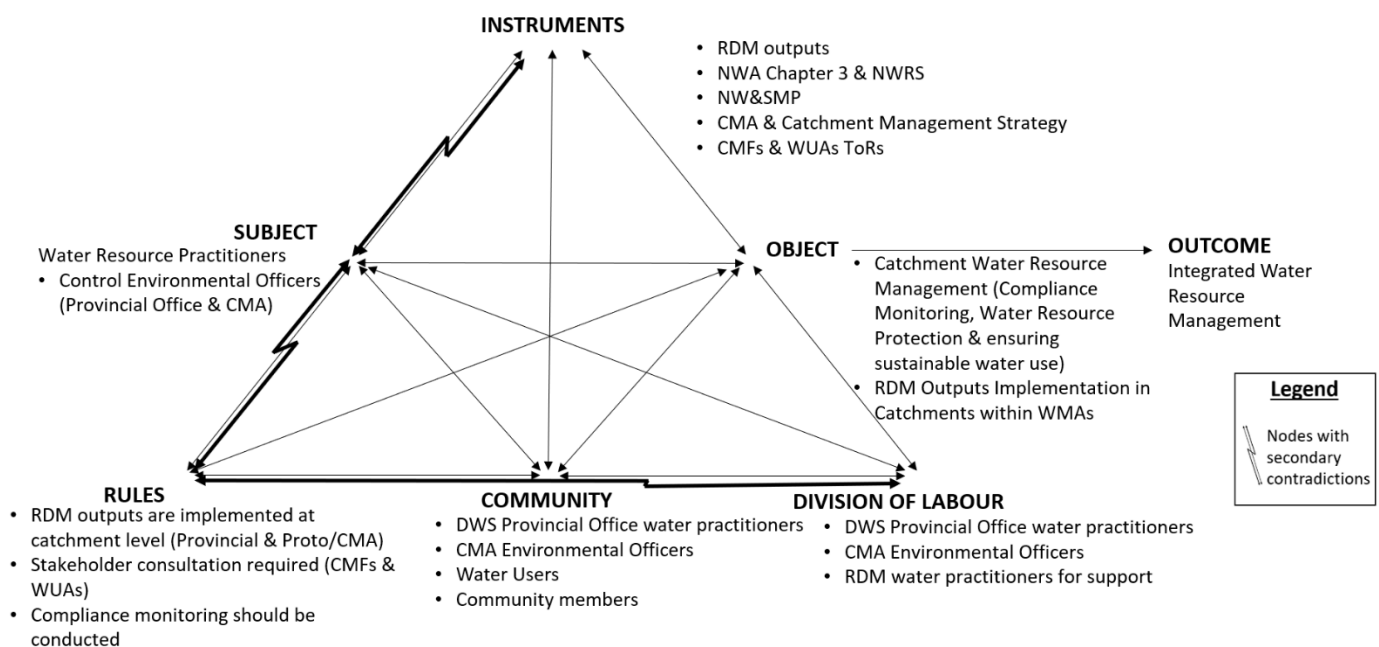


Figure 6.2: Provincial office and CMA RDM implementation activity system

Source: Author

6.3.2.2 Provincial Office and CMA RDM implementation activity systems description

In the provincial office and CMA RDM implementation activity system for case study 2 and 3 (see Figure 6.2), the *object* is catchment level water resource management. This includes a focus on water quality and quantity compliance monitoring, water resource protection, through RDM implementation, and overall water resource management at a catchment scale. The *outcome* is integrated water resource management. *Instruments* include the gazetted RDM outputs, that is, Classes, Reserve, and RQOs, together with the NWA and CMS and

catchment level action plans, such as water quality management strategies. The *subjects* (role-players) conducting the work are local water resource practitioners, such as control environmental officers and catchment managers in provincial offices or CMAs. The *rules* include the consideration of RDM outputs in determining catchment water resource management *tools* on a local scale, such as water use license conditions and stakeholder consultation in local forums.

The RDM approach for all projects completed to date, is that local water resource practitioners ought to participate in the project management and project steering committee structures in RDM determination projects, to provide catchment data and enable implementation in later stages. These *subjects* extend to the *community* which further includes interested and affected community members and the water users in the catchment. The *community* interacts in platforms such as CMFs. The *division of labour* is between provincial office control environment officers and their CMA counterparts, with support from RDM project managers.

(a) Case study 2: KZN Province RDM implementation description

In addition to the description provided in Section 6.3.2.2, the KZN Province RDM implementation activity system consists of water resource management practitioners, based in the KZN provincial office, as role-players, mandated with the implementation of RDM. This is one of their functions within the overall suite of catchment management activities. The CMA in this province is not yet fully functional. Therefore, some of these staff members function within a proto-CMA.

(b) Case Study 3: Mpumalanga IUCMA RDM implementation activity system description

The Mpumalanga Inkomati Usuthu Catchment Management Agency (IUCMA) RDM implementation activity system, in addition to details in Section 6.3.2.2, consists of role-players in the IUCMA, water resource management practitioners mandated with RDM implementation, one of their functions within overall catchment management activities, in a fully functional CMA.

6.4 ACTIVITY SYSTEMS REVISED WITH ROLE-PLAYER INPUTS AND CONTRADICTION ANALYSIS

As guided by Engeström and Sannino (2011), contradiction analysis of role-player experiences was conducted in Phase 2. This sought to identify the eight kinds of discursive manifestations of deeper underlying contradictions, namely *conflicts*, *critical conflicts*, *dilemmas* and *double binds* (Engeström & Sannino, 2011), adding also *tensions*, *conflicts of motive*, *disturbances* and *inconsistencies* (Jalasi, 2018), described in Section 3.5.3. Noting that, contradictions are distinguished and categorised into primary, secondary, tertiary and quaternary levels. This distinction is necessary because contradictions develop as the activity system nodes interact with each other. In CHAT, primary contradictions are found within a single node of an activity system and reflect fundamental tensions, while secondary contradictions develop between two ‘corners’, for example, *subjects* and *rules* within an activity system (Foot, 2014). Tertiary contradictions within an activity system arise when the *object* of a more ‘culturally advanced’ activity (Engeström, 1987) is introduced into that system. The motive for introducing a new *object* to an activity system is typically to find relief from one or more secondary contradictions and the tensions stemming from them. The introduction of a new *object* can also trigger a developmental phase through which the activity system will be redefined and reconfigured. Triggered by a ripple effect from efforts to remediate tertiary contradictions, quaternary contradictions arise between the central activity and its neighbouring activity systems when a new form of practice is employed based on a reformed and/or expanded *object* (Foot, 2014).

During Phase 2 engagements (group discussions and interviews), role-players made inputs into the activity systems that were initially compiled during document analysis. Role-player inputs added experiential learnings that were not found during document analysis to the activity systems. Analysing their inputs in the activity systems led to further identification of manifestations of contradictions. The changes in activity systems following role-player inputs are demonstrated in blue texts in Figures 6.3 and 6.4. Figure 6.3 shows the National Office RDM determination activity system with inputs made by role-players and manifestations of contradictions that were derived thereafter. The secondary category of manifestations of contradictions, between the nodes of the activity system, are depicted with “lightning-shaped

double headed arrows”, borrowed from Engeström and Sannino (2021, p. 9) in the activity systems. Role-players voices are captured in italics in this section to provide clarity on relevant contradictions for each of the analysed case studies.

6.4.1 Case study 1: National Office RDM determination activity system

In the National Office RDM determination activity system, role-players added to the *rules*, indicating that *the final RDM outputs are gazetted and therefore legally binding*. In addition, role-players in the KZN Provincial RDM implementation activity system (see Section 6.3.2.2 [a]) made inputs that were relevant to this national activity system, indicating *the need for creation of RDM tools with local implementors with the support of institutions with a shared water resource protection mandate*. These local implementation role-players also emphasised the need for a community strategy to communicate in simplified language from the National Office to implementers on the ground. Figure 6.3 illustrates the more detailed National Office RDM determination activity system with role-player inputs.

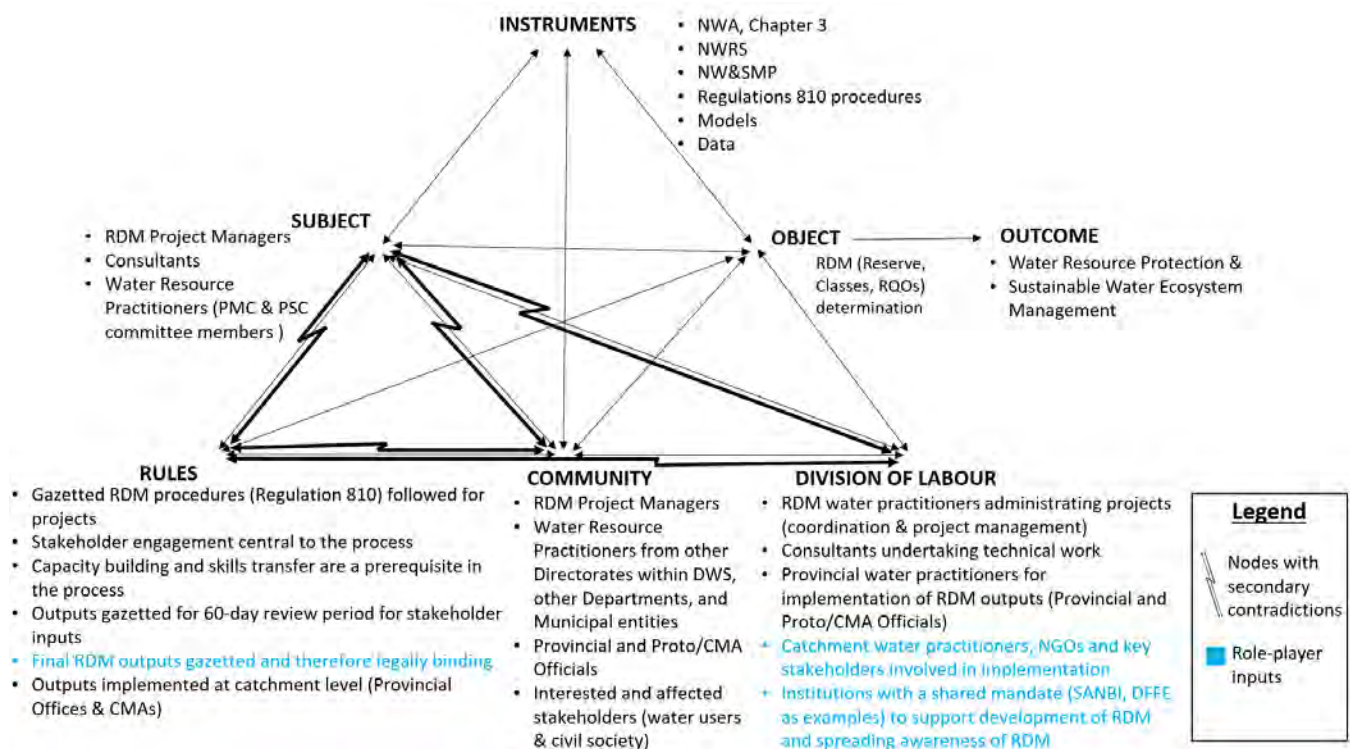


Figure 6.3: A more detailed version of the National Office RDM determination activity system following role-player inputs

Source: Author

In the National Office RDM determination activity system, a number of manifestations of contradictions were identified as I read into and across the sampled documents and listened to the voices of role-players. Contradictions were therefore found in the activity system. Since these contradictions cannot be observed directly (Engeström and Sannino, 2011), they were traced and identified through their manifestations (see Section 3.5.3) in the different types of discursive manifestations of contradictions. These manifestations of contradictions are introduced and discussed next according to their categories of primary, secondary and tertiary in Sections 6.4.1.1 and 6.4.1.2, found in this study.

6.4.1.1 Primary contradictions

(a) Primary contradiction 1: Shifting object boundaries versus the need for RDM determinations countrywide

In the *object* of RDM determination, boundary revision of Water Management Areas (WMA), to integrate catchment areas, resulted in a change from 19, established in the NWRS 1 (South Africa. DWAF, 2004), to nine in the NWRS 2 (South Africa. DWA, 2013) and, recently, 6 gazetted in the NWRS 3 (South Africa. DWS, 2023) (see Table 1.3). A *disturbance* as these boundary revisions historically omitted portions of the newly demarcated WMAs from RDM projects where these projects were previously completed under the old demarcations. This adds a layer of complexity as RDM projects, for determining the Classes, Reserve and RQOs have historically not been undertaken concurrently. There is a need to update necessary information at the start of the majority of projects, and with the new demarcations, a need also arises to complete RDM determinations for outstanding catchments in each WMA demarcated boundary. Where projects were completed for all areas, scattered information has been generated between old and new boundary identities.

As examples of stakeholder concerns, questions have historically been raised in this regard, *by the time we are done with this project, most probably Usutu [catchment] would have merged with Inkomati, are you still going to go through the same process with the Usutu? Also, will the process of classification change the preliminary Reserve?* The institutional response provided was that *the preliminary Reserve will be reviewed and in some EWR [Ecological Water Requirements] sites where there are changes, the Reserve will be updated*

through this project (OD-PR-IRR7-Inkomati). In addition, role-player AS3.1-RP3 attested that *the Usutu Catchment was added to the Inkomati area demarcation later, so it was not included in the Inkomati RDM project; as a result this RDM project is only underway now. The new added area will always be at the back-foot in terms of implementation efforts.* This data from the Inkomati IRR report (OD-PR-IRR7-Inkomati) shows that it also adds to uncertainty among implementers, and presumably also incurs additional costs, although the aim might well be to deal with budget constraints.

Furthermore, the transition from 19 to nine and then to the current six WMAs is contradictory to the initial aim of decentralisation, as the number of WMAs keep decreasing as though centralising WMAs instead. Arguably, this might be an integration effort to curb the challenge of financial resource availability, hence a *critical conflict*.

(b) Primary contradiction 2: Lack of review provision for RDM outputs

A primary contradiction was surfaced in the *rules* where RDM outputs are published in the government gazettes at the end of each project and become legally binding. These outputs are taken into consideration in processing water use license applications. As an example, elaborated by Dollar et al. (2010), if a water resource is afforded a Class I in the RDM outputs, its protection measure will not allow developmental use of the resource. However, the lack of a review or revision period for these outputs provides no means for effecting amendments to this initial provision. The *double bind* arises in that this situation can be both enabling and challenging. Enabling from an ecosystem protection viewpoint and challenging in terms of economic water resource use. As an example, *when is the Water Resource Class going to be reviewed?* was asked by various stakeholders across various RDM projects through the IRRs (Table 1, OD-PR-IRR2-Vaal, OD-PR-IRR6-Mvoti, OD-PR-IRR7-Inkomati). In addition, a major challenge with the lack of review provision, expressed by role-players, is that *wrong information or errors cannot be easily corrected (AS1.1-RP4)*. This challenge has long been identified in the organisation and a role-player indicated that *currently, the DWS is busy on the Amendment Bill, which incorporates the review of RDM outputs and specifies some time frames. This is a lesson learnt, brought about by stakeholders during various project meetings and consultations (AS1.1-RP10).*

(c) Primary contradiction 3: Changing instruments

Because of capacity challenges, including in both skills and *tools*, RDM projects have largely been outsourced to project consultant teams (see Appendix 2) over the years, leading to the manifestation of a secondary contradiction, namely *tension*, described next in Section 6. 4.1.2 (a). Each consultant team uses their own *instruments*, for example, different versions of models, leading to different applications of the Regulation 810 procedures for determination of RDM. There are, therefore different presentations of outcomes resulting in a lack of standardisation, as outlined in Chapter 5 Section 5.4.1. RDM implementers in the provincial and CMA offices have commented on this *inconsistency* indicating that different approaches and presentations of the outputs create confusion. This contradiction also raised disagreement [as above] among role-players, with some not seeing the need for standardisation.

(d) Primary contradiction 4: The capacity building rule

Consultants working with RDM experience a primary contradiction. As they provide specialist services to clients in environmental management, they also derive an income for themselves. They practice environmental science “within a socio-economic system which exchanges this service for financial compensation” that enables the consultancy “to sustain its, increasingly costly, operations” (Foot, 2014, p. 21). Thus, the *object* of a typical RDM activity system is inextricably dual for the consultancy, fostering environmental health and increasing revenue, a *double bind*. Foot (2014, p. 22) elaborated that:

This fundamental tension ... the primary contradiction, keeps the activity system in constant tension and surfaces in everyday contexts, in various forms and in other levels of contradiction. The primary contradiction therefore is not only continually present, but it also serves as a foundation for other levels of contradiction, for example Even if attempts to resolve these other levels of contradictions are temporarily successful, the primary contradiction remains.

Further guided by Foot (2014, p. 22), other types of secondary contradictions prompt latent primary contradictions in the activity system to surface and take the form of a specific problem as tension builds between different parts of an activity. In this National Office case

study activity system, a secondary contradiction can be seen among the organisational cultural norms, or *rules* (see Section 6.3.1.2). In the National Office RDM determination activity system, the primary contradiction caused by the dual motive of consultants to earn a living as well as environmental protection is exacerbated through the imposition of a *rule* that requires consultants to transfer skills, to ensure officials are capacitated to execute functions themselves. This is in direct opposition to the need for consultants to earn a living through continuous running of the consultancy. In this situation the primary contradiction is translated into a secondary contradiction, in which the *rule* and *subjects'* service offering, in the *object* of RDM determination, are in opposition to one another. On the other hand, it is both a *dilemma* and a *double bind* for DWS, if it outsources the work, it does not build the capacity itself. On the other hand, if DWS does not outsource, the full work process cannot be completed in-house. This links to Sections 6.4.1.2 (a) and (b) on outsourcing challenges, detailed next.

6.4.1.2 Secondary contradictions

(a) Secondary contradiction 1: Outsourcing

A secondary contradiction was surfaced in the *division of labour* and *subjects* nodes of the activity system. Here technical tasks in the determination of RDM are conducted by consultant teams while RDM project managers administer the projects, through coordination and management. This poses a *tension, dilemma, double bind* and challenge for implementation later in the process when consultants' contracts are completed, and RDM project managers are expected to provide support and guidance to regional officials on the technical outcomes for translation into implementation *tools*, such as water use license conditions for example.

Role-players have reflected that the institution has over time become reliant on consultants, such that even components that can be conducted internally are outsourced. As a result, RDM project managers are, in the end, not equipped to support implementing units, like the provincial offices and CMAs, as they lack the practical experience of determining RDM outputs. Role-player views on this outsourcing challenge are captured in Chapter 5 (see Section 5.4.9), summarised in a nutshell in this quotation: *Where technical components of the*

work were outsourced, managers will thereafter not understand the technical components that went into it nor the rationale behind it (AS1.1-RP7).

(b) Secondary contradiction 2: Capacity building challenge despite high value placed on it

A secondary contradiction found between the *rules* and *subject* nodes relates to efficiency of capacity building. Skills transfer among the *subjects* is a key requirement (*rule*) in the RDM process. However, I found this to extend only as far as records of theoretical sessions and some fieldtrips attended by recipients, with no practical execution of technical tasks within the project. Historically, there is no evidence of assessing whether skills transfer actually took place, whether training needs have been established, and how capacity development is tailored to individual or changing needs. There are, for example, no records of learning needs assessments, tailored training plans for training specific recipients, or evaluation of training outcomes. While these may exist, they have not been regarded as sufficiently important to report and were not found in this study.

Based on the continued outsourcing tension of all technical components of RDM studies to consultant teams (see Appendix 2), it would appear that capacity development is insufficient and inefficient. Other factors relating to capacity challenges seem to be institutional. Multi-expert teams are required to undertake each project due to the different environmental components involved in RDM determination and IWRM, more broadly. Such teams are not in place in the activity system. There are multiple reasons for this. Firstly, where expertise is available in DWS, it would not meet all the required areas of specialisation due to skills shortages. This is an institutional capacity challenge in terms of a limited number of staff available with skills to conduct the work, due to, for example, a lack of succession planning and high staff turnover, among others, an *inconsistency* in the mis-match of skills needed versus those available to conduct the expected work. Secondly, available expertise is located in different units of the institution and team compilation internally would span across these units, rendering coordination challenges. Thirdly, there is a limitation in terms of the necessary *tools*, such as functional models, needed to execute projects nationwide for all catchments. Lastly, due to limited financial resources for providing frequently changing versions of *tools*, such as models or compatible computers, among others. These limited

resources also inhibit processes that enable hands-on staff participation in projects, through supporting, for example, travel to field work or continuous training on changing models. Further, covering entire project areas nationwide for all catchments, also emerges as a challenge linked to limited financial resources. Hence a picture emerges of multi-dimensional capacity issues in terms of technical skills, institutional, coordination and financial capacity.

Capacity building and skills transfer are a pre-requisite in project ToRs. Yet skill challenges appear to persist due to two institutional factors, namely the structure of units and coordination of capacity building efforts. Units in the RDM determination activity system (see Figures 6.1 & 6.2) should be resourced with staff members linked to their functional mandates, or intended outputs in terms of their expertise. The coordination of capacity building as explained by role-players in Chapter 5 (see Section 5.4.9) needs attention.

Therefore, a picture of manifestations of contradictions in the form of *tensions* and *inconsistencies* is apparent when it comes to capacity building. Following my IIE MSA symposium participation (see Section 3.4.2.3 [b]), capacity building appears to be a full *object* on its own, a sub-activity system emerging as illustrated in Figure 6.7.

(c) Secondary contradiction 3: Inadequate stakeholder engagement

Stakeholder consultation is a core requirement or *rule* in RDM projects. As detailed in DWS (2016), it is a process of obtaining the public's view, representing many sectors of society, for consideration by DWS, as the water management authorities, for inclusive, transparent and fair decision-making. The *rules* of RDM determination require the process and outputs to be generated by *subjects* jointly with interested and affected stakeholders, the *community*, through participation and negotiation. According to the reports analysed, however, stakeholder consultation is limited to the number of meetings scheduled during the RDM project phases. Provincial offices and CMAs are expected to consult interested and affected parties further through Catchment Management Forums (CMFs) and Water User Associations (WUAs), at a localised level and as part of their local water governance processes. RDM project managers should use these structures to support provincial offices and CMA through

this stakeholder engagement processes, also meant to also assist with technical complexities, such as explaining the implications of RDM outputs.

Historically, RDM practitioners conducted stakeholder engagement through CMFs, attended by a wide range of local stakeholders, and so closing the loop on the range of stakeholders consulted in RDM projects. This provided also a capacity building opportunity to interact with the technical contents of RDM projects and explain these to local stakeholders. In this way they addressed both stakeholder engagement and capacity building. However, AS1.1-RP8 outlined a change in stakeholder engagement where *RDM project managers no longer attend forums to engage [with] stakeholders; they instead train regional officials on the RDM content to ensure they take the information forward. This has been beneficial in terms of cutting costs and capacity building for provincial officials to understand project outcomes* (AS1.1-RP8). AS3.2-RP1 confirmed this change, but however, disagreed with the capacity building point, citing that *I am a CME [Compliance Monitoring and Enforcement] official, on the authorisation side, I wouldn't be able to deliver such a presentation to the CMF* [due to lack of knowledge and understanding of RDM].

Stakeholder involvement and public participation is, entrenched as a *rule* in RDM processes for ensuring involvement of interested and affected parties. How stakeholder engagement is executed, and the efficiency thereof, emerges as a major factor in this study. Role-player experiences in this regard are detailed in Chapter 5 (see Section 5.4.10). No longer conducting stakeholder engagement at forums appears as a *dilemma* in the activity system with incompatible motives. On the one hand, supporting cost curtailments and, on the other, sacrificing both capacity building and stakeholder engagement, both of which have been identified as key institutional *rules* for RDM determination and implementation.

Despite legislation requiring significant stakeholder engagement as an integral part of RDM, processes are hampered by several challenges, including limited understanding of the purpose and how processes can be tailored for different stakeholder groups, as well as budget constraints. Therefore, a picture of manifestations of contradictions in the form of a *dilemma*, *inconsistency* and *conflict of motive* surfaces when it comes to stakeholder engagement.

Similar to, and intertwined with, capacity building, stakeholder engagement appears to be a full *object* on its own, a second sub-activity system emerging within the RDM determination activity system as illustrated in Figure 6.7.

6.4.1.3 Tertiary contradiction

A new directorate was added to the National Office RDM determination activity system, called Source Directed Studies. Technical work in this directorate is expected to be conducted internally without the use of consulting services, a new *object*. As described in the introduction to Section 6.4, the motive for introducing a new *object* to an activity system is typically to find relief from one or more secondary contradictions and the tensions stemming from them. The introduction of in-house projects was meant to relieve over reliance on outsourcing, a contradiction found in the RDM determination activity system.

6.4.2 Case study 2: KwaZulu-Natal (KZN) Province RDM implementation

The KZN Provincial Office RDM implementation activity system (see Figure 6.4) consists of role-players based in the DWS provincial office and proto-CMA. These are water resource management practitioners mandated with implementation of RDM as part of their job functions within the overall catchment management activities.

In KZN, semi-structured interviews were undertaken with role-players to solicit their practical experiences in the activity system. I also got an opportunity to co-host a workshop with role-players from the South African National Biodiversity Institute (SANBI) uMngeni Ecological Infrastructure Partnership (UEIP) and DWS KZN provincial and proto-CMA offices, as a further engagement platform with role-players. This provincial implementation activity system (see Figure 6.4) was initially mapped using document analysis from Phase 1 and shared with KZN role-players during the workshop. The workshop provided an opportunity to engage with an array of sector stakeholders from various provincial institutions. Provincial role-players made valuable inputs into the activity system, using sticky notes, and inserted into Figure 6.4 from their insights and learnings experienced in this activity system. As can be seen on the inserted picture of the workshop board sticky notes and blue texts in Figure 6.4, KZN provincial role-

players made a lot of inputs that was not found in the analysed documents prior to the workshop about the provincial activity system. Their input provided information on the practical situation in the province.

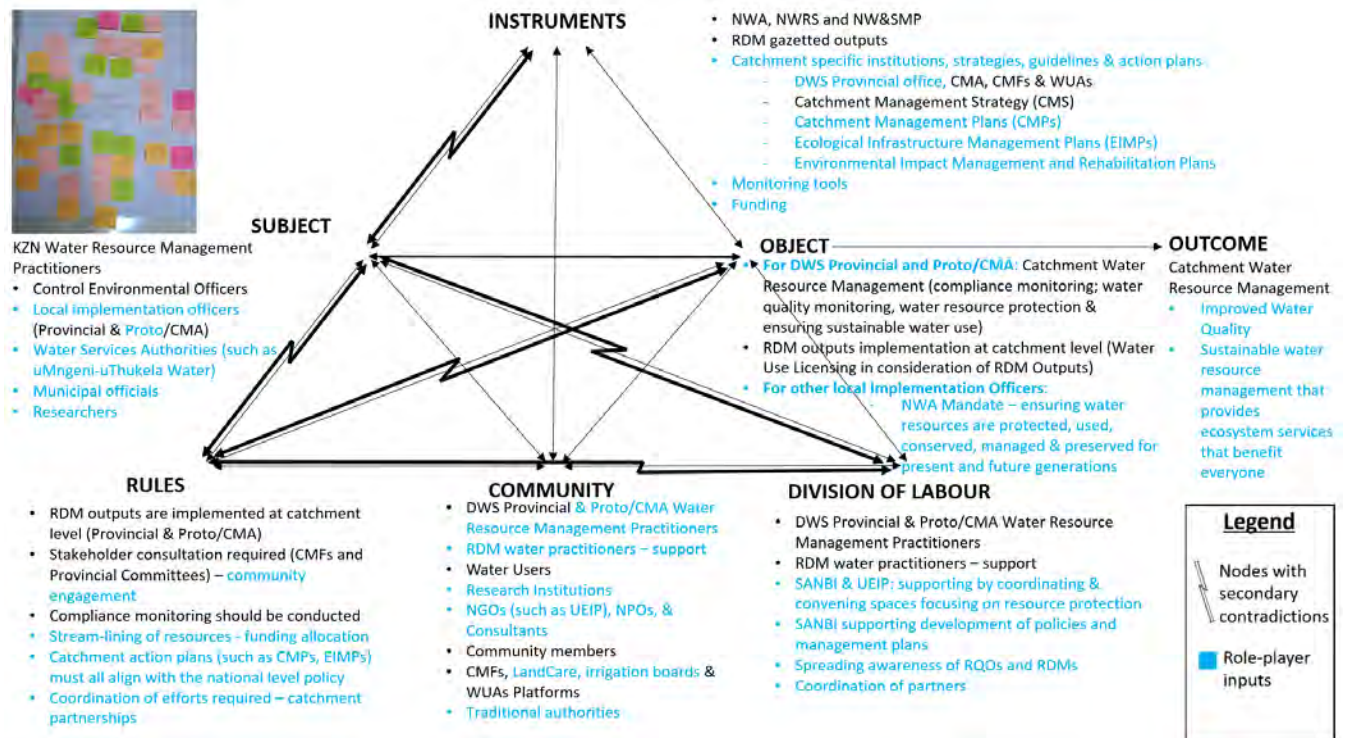


Figure 6.4: KZN Provincial Office RDM implementation activity system with role-player inputs

Source: Author

6.4.2.1 Primary contradictions

All the primary contradictions identified in the National Office RDM determination activity system, namely challenges relating to shifting geographic boundaries, a lack of review of outputs, differing interpretations, *instruments* and practices, and capacity building, (see Section 6.4.1.1 [a] to [d], respectively) are applicable to the KZN Provincial Office RDM Implementation Activity System, as outputs, determined at the National Office are implemented at the catchment level.

(a) Primary contradiction 1: Engagement of implementers through project meetings

A primary contradiction was found in the *rules* as part of the organisational approach, where provincial officials form part of the RDM determination process, participating in project committees and workshops for technical components of this process. The contradiction emerges when RDM implementation appears to be a challenge, provincial officials unable to translate them into catchment management tools as reported in South Africa. WRC, 2018 & 2021). Based on the document analysis in Phase 1 alone (see Section 3.4.1 & Chapter 4), it was not clear how officials, having been full participants in the process, had a challenge to implement. Based on role-player insights, challenges appear to be due to misunderstanding and mis-interpretation of RDM outputs. Hence, a challenge on the translation of RDM outputs into implementation *tools* or programmes.

6.4.2.2 Secondary contradictions

Secondary contradictions (b) and (c) identified in the National Office RDM determination activity system are also applicable to the KZN Provincial Office RDM implementation activity system. These include contradictions related to the challenges of outsourcing, capacity building and stakeholder engagement (see Section 6.4.1.2 [b] & [c]). In addition, the specific secondary contradictions, fragmented implementer participation, transitions from determination to implementation, a lack of clear roles and responsibilities and limited stakeholder engagement, discussed below, were identified in this activity system .

(a) Secondary contradiction 1: Rules, subjects and division of labour – implementers participation in RDM projects fragmented

A secondary contradiction was found in the *rules*, *subjects* and conversely the *subjects* and *division of labour* of the activity system. The institutional arrangement of DWS has a *rule* that RDM implementation must take place at a provincial level. Role-players made many inputs in this regard indicating that *it is fitting/appropriate that implementation should be at a localized level. However, what is needed is that implementation is conducted together between provincial and national office staff in cooperation* [with one another]. *This would assist them with ensuring accuracy of interpretation of RDM outputs* (AS1.1-RP7).

A challenge explained by role-players is that *participation of local implementation officers in RDM projects is fragmented across the various divisions of the provincial institution leading to officials not having enough knowledge on completed projects (AS2.1-RP3)*. This contradiction leads to a challenge of misunderstanding and misinterpretation of RDM outputs. Hence, a challenge on the translation of RDM outputs into implementation *tools*, such as water use authorisations and catchment management programmes, for example, leading to a *conflict* with water users. This contradiction ties back to the contribution made by role-players in the National Office case study on the collaborative development of *instruments* alongside local implementors and stakeholders.

(b) Secondary contradiction 2: Instruments and subjects – handing over RDM outputs

Linked to (a) above, a secondary contradiction was found in the *instruments* and *subjects* of the RDM implementation activity system, where it was not clear in documents analysed, how RDM outputs are handed over for implementation at catchment level. It would seem, from role-player experiences, that information is exchanged in technical reports that are not in user friendly formats, and presented with technical complexity not easily understood at project stakeholder meetings. The lack of a transitional handover from consultants conducting the technical work to water resource management officials, both at national and regional level, leads to this contradiction which later resurfaces in the form of inefficient implementation of RDM, seen in the challenge of translating RDM outputs into *tools* and programmes. WRC studies documented this challenge indicating that they have found misunderstanding and misinterpretation of RDM outputs (South Africa. WRC, 2018 & 2021). Role-player inputs in this regard provided clarity as detailed in Section 6.4.2.2 (a) above.

(c) Secondary contradiction 3: Rules, subjects and division of labour – lack of clear roles and responsibilities

A secondary contradiction was found in the *rules*, *subjects* and *division of labour* of the activity system. The institutional arrangement requires that implementation takes place at a provincial level. In the absence of functional CMAs for the vast majority of catchments, implementation of RDM functions at local level is compromised due to capacity constraints of DWS provincial offices. It has been found that where there are no functional CMAs, DWS provincial offices must function as proto-CMAs as well as fulfil other functions. The

contradiction appears as a *conflict of motive* with regards to the implementation mandate of provincial institutions, not sufficiently resourced to conduct the work. Linked to this, because of the *division of labour* between role-players, another implementation challenge, found in the document analysis, was the misinterpretation of RDM outputs as noted in 6.4.2.1 (a).

(d) Secondary contradiction 4: Rules, subjects, division of labour and instruments/tools

The *rule of stakeholder engagement and consultation* is core to RDM determination and requires outputs to be generated jointly DWS (2016), through participation and negotiation, among interested and affected stakeholders (see also Section 6.4.1.2 [c]). According to the reports analysed, mainly IRRs (see Section 3.4.1.5 and Table 3.2), stakeholder consultation in the determination of RDM is, however, limited (see Section 6.4.1.2 [c]). Stakeholder engagement is facilitated through a number of meetings that are scheduled during the project phases, through which provincial implementation personnel are also consulted. CMFs, WUAs and catchment committees are intended for consulting interested and affected parties at a local level of governance. These forums and platforms are also meant to assist stakeholders with processing the technical complexity of the process. The secondary contradiction arises in the form of *conflict of motive*, where provincial offices, that also act as proto-CMAs, but are not adequately resourced, in terms of skills and budgets to fulfil the full spectrum of their functions, including the implementation of RDM.

6.4.3 Case study 3: Mpumalanga Province RDM implementation

In the Mpumalanga Province, semi-structures interviews were undertaken with role-players focused on their practical experiences in the case studies. On engagement with Mpumalanga role-players, it was found that the IUCMA and the provincial office were responsible for different catchment areas, divided geographically. As a result, the Mpumalanga provincial implementers case study surfaced two activity systems. One was made up of role-players based in the IUCMA. The other was the DWS provincial office, acting as a proto-CMA at the time of data generation, mandated with implementation of RDM as one of their functions within catchment management. The activity systems were therefore mapped separately for the Mpumalanga IUCMA RDM Implementation Activity System and the Mpumalanga Olifants Proto-CMA RDM Implementation Activity System.

6.4.3.1 Mpumalanga IUCMA RDM Implementation Activity System

The Mpumalanga IUCMA RDM implementation activity system was mapped building on information from the document analysis in Phase 1 of the study (see Section 3.4.1 & Chapter 4). The provincial implementers activity system that was initially drawn was updated, as in Figure 6.5, to surface the voices of the role-players in terms of their insights and learnings experienced in this activity system.

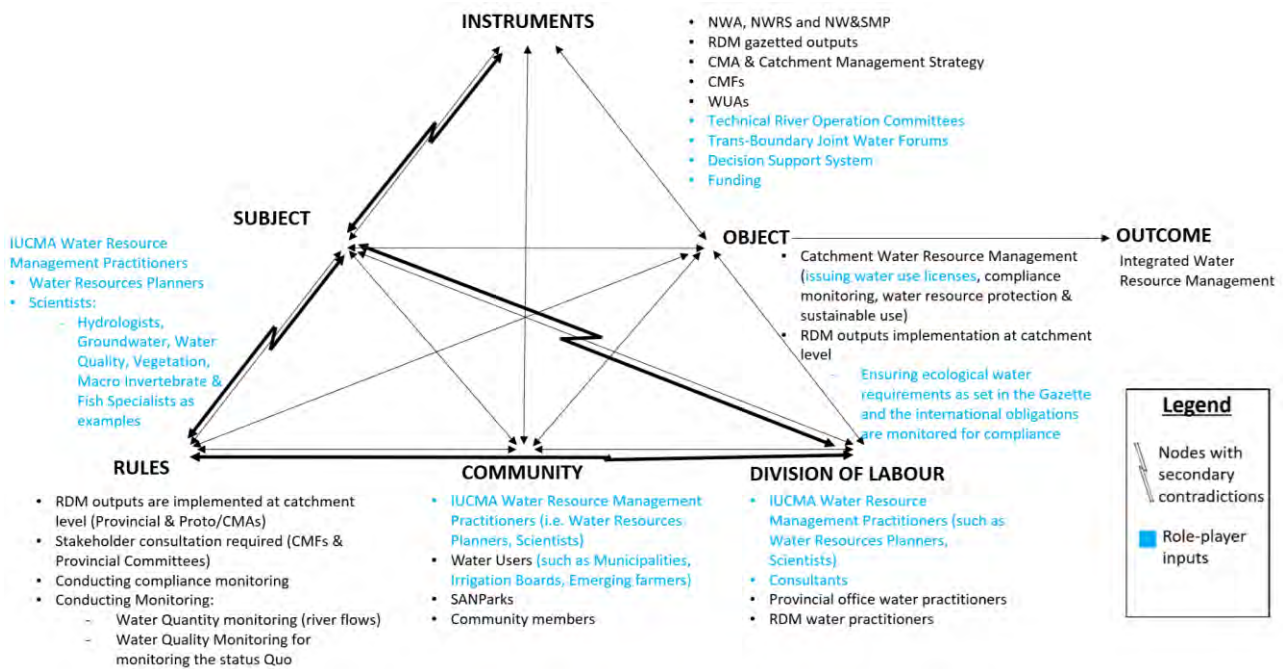


Figure 6.5: Mpumalanga IUCMA RDM implementation activity system with role-player inputs

Source: Author

(a) Primary contradictions

All the primary contradictions identified in Section 6.4.1.1 (see related Sections [a] to [d]) for the National Office RDM determination activity system, including the revision of boundaries, no mechanism for reviewing RDM outputs, varied *instruments* and practices and capacity challenges, and Section 6.4.2.1 for the KZN Provincial Office RDM Implementation Activity System, challenges associated with the engagement of implementers (see Section 6.4.2.1 [a]) are also applicable to this IUCMA RDM Implementation Activity System.

In terms of the primary contradictions detailed in Section 6.4.1.1, that *although the nature of government Gazettes provides a legally binding tool for ensuring adherence to RDM outputs, the lack of a revision period provides no means for effecting amendments*, role-player AS3.1-RP3 added that *the gazette does not provide the full duration curve, only the 60th and 90th percentile which are not achievable under specific catchment circumstances*. Secondly, *RDM outputs need to be made readily available to identified implementing institutions beyond gazetting and posting on the DWS website*.

(b) Secondary Contradictions

Capacity and stakeholder engagement challenges, identified as secondary contradictions in the National Office RDM determination activity system (see Section 6.4.1.2 [b] & [c], respectively) and secondary contradictions around fragmented participation, handing over of RDM for implementation and stakeholder engagement in the KZN Provincial Office RDM Implementation Activity System (see Section 6.4.2.2 [a], [b] & [d], respectively) are similarly applicable to the Mpumalanga IUCMA RDM Implementation Activity System. In addition, the following activity system specific secondary contradiction was identified.

(i) Instrument, subject and object – implementation transition needs

In the Mpumalanga IUCMA RDM implementation activity system emphasis was placed on a transition process needed to facilitate RDM implementation at catchment level. This was a key finding in the current study and was substantiated with role-player voices. AS3.1-RP3 identified the implementation transition needs as follows:

- *the technical information needs to be explained to implementers; duration curves are not understood by all [staff] members; [and]*
- *efforts must be made to identify the dedicated personnel who are responsible for implementation of the project outputs and a full suite of technical information needs to be provided to them [directly].*

6.4.3.2 Mpumalanga Olifants Proto-CMA RDM Implementation Activity System

The emerging Mpumalanga Olifants Proto-CMA implementation activity system was mapped in Figure 6.6, around DWS provincial office role-players operating as the Olifants Proto-CMA

at the time of study. These *subjects* are water resource management practitioners mandated with the implementation of RDM as one function within their overall catchment management activities.

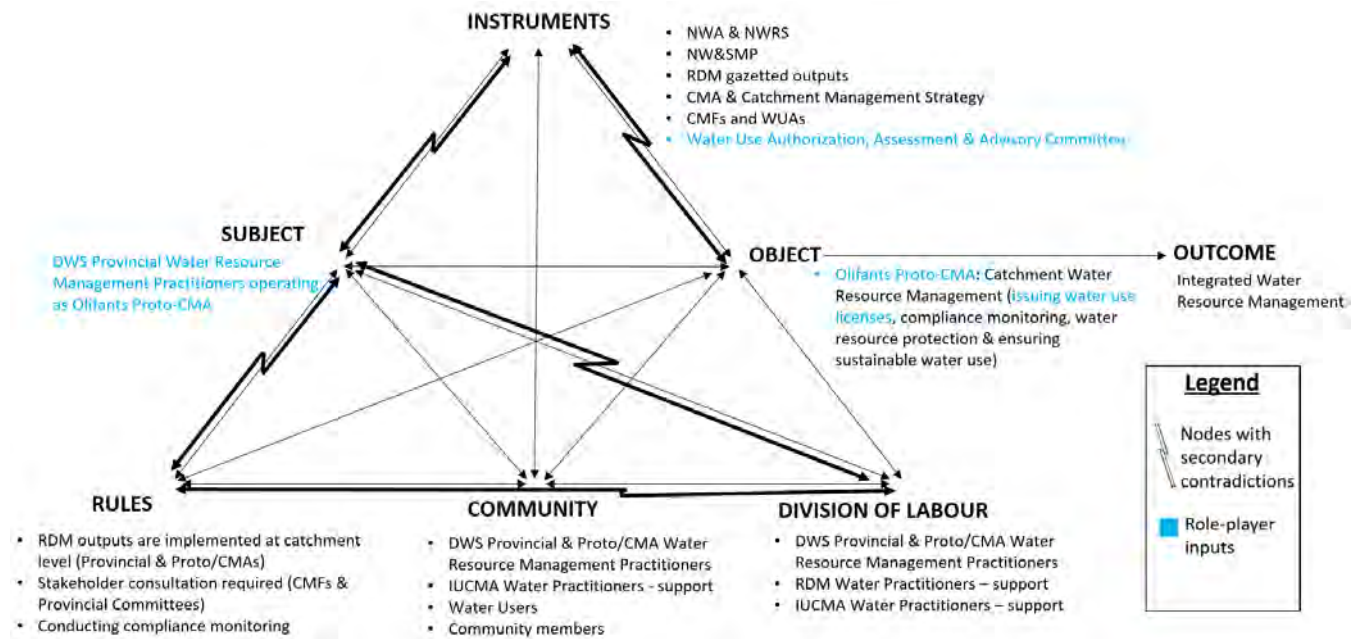


Figure 6.6: Mpumalanga Olifants Proto-CMA RDM implementation activity system with role-player inputs

Source: Author

(a) Primary contradictions

The primary contradictions identified in Section 6.4.3.1 (a) for the Mpumalanga IUCMA RDM implementation activity system, including the revision of boundaries, no mechanism for reviewing RDM outputs, varied *instruments* and practices, capacity challenges, and section 6.4.2.1 for the KZN Provincial Office RDM implementation activity system challenges associated with the engagement of implementers (see Section 6.4.2.1 [a]), are applicable to the Mpumalanga Olifants Proto-CMA RDM Implementation Activity System, building on the challenge of engaging implementers, further explained in Section 6.4.2.1.

(b) Secondary contradictions

The secondary contradictions identified in the Mpumalanga IUCMA RDM implementation activity system, emerging from the challenge of transitioning determination outputs to implementation, are applicable to the Mpumalanga Olifants Proto-CMA RDM Implementation Activity System (see Section 6.4.3.1 [b]). Like the Mpumalanga IUCMA RDM implementation activity system, role-players in the Mpumalanga Olifants Proto-CMA RDM implementation activity system emphasised the need for RDM implementation guidance at catchment level. Role-player voices substantiated these findings, as detailed below.

(i) Instrument, subject and object: Implementation transition needs

In terms of the secondary contradictions detailed in Section 6.4.2.2 (a), that *RDM outputs ought to be implemented on catchment level, while there is no provision of a handover process or clear instruction/training on how to implement them*; role-player AS3.2-RP1 confirmed that *there is no clear instructions on how to implement RDM outputs nor training. RDM outputs are just a gazetted document that is placed on the DWS website once the project is completed. There is no follow-up on implementation.* In this activity system there was no evidence of RDM implementation efforts being made and or leveraging on such efforts from the neighbouring functional CMA.

Moreover, role-players in this Mpumalanga Olifants Proto-CMA implementation activity system expressed that *the challenge is that Head office is not available when regional officials need help. When stakeholders make enquiries, RDM staff members are not readily available. This inaccessibility is prevalent even internally among staff members, emails don't have signatures for contact details; the directory in some cases doesn't have the full details of members. This issue demonstrates [a] lack of accountability (AS1.1-RP7).* This links to the point raised by other role-players that *the final product that is received by provincial offices is through technical reports for which RDM project managers were not hands-on (AS1.1-RP10).* These points made by role-players demonstrate a tension between DWS officials at the national office and those at the provincial and catchment management levels on the implementation of RDM.

6.5 FINDINGS: ACTIVITY SYSTEMS CONTRADICTIONS AND INTERLINKAGES

6.5.1 Contradictions in the activity systems

All four types of discursive manifestations of contradictions, that is *conflicts*, *critical conflicts*, *dilemmas* and *double binds*, described by Engeström and Sannino (2011), were evident in the analysis of South Africa's RDM activity systems. In addition, *tensions*, *inconsistencies*, *conflict of motive* and *disturbance* were also evident. In the next section, I discuss the fundamental systemic contradictions that stood out in this analysis, what role-players understood to underlie these, efforts to address them as existing learning in the system, and the recommendations of role-players, reflecting potential for future learning.

The National Office RDM determination activity system is replete with *conflicts* (see Section 6.4.1). There is a high level of criticism of government in its failure to put functional institutional provisions in place to achieve the intentions of the NWA (South Africa, 1998). This manifests, for example, in both scientists and local provincial and catchment water resource practitioners pointing out the absence of functional CMAs as the intended implementation agencies. This is coupled with the repeated reduction in the number of WMAs according to which water resources are to be managed, the ensuing inconsistencies in measures already taken, and information scatter. At the local catchment level, practitioners argue that additional areas in the demarcation of WMAs will always create a lag in implementation progress.

Consultation with the public or stakeholder engagement was a frequently occurring contradiction (see Sections 6.4.2.1 [c] & 6.4.2.2 [d]), appearing in reports such as the IRRs (see Section 6.4.2.2 [d]). Officials are aware that they need to consult communities, and some believe this is done adequately. Others experience a *dilemma* because RDM staff lack framing through an accessible narration of the overly technical process due to the work having been outsourced. This *dilemma* extends to the lack of human resource capacities for continuous engagement of stakeholders at established platforms. As a result, consultation seems cursory, even non-existent, or poorly insufficiently executed for the intended purpose of ensuring participation of interested and affected parties. The *dilemma* of consultation points to a

fundamental contradiction, as the NWA (South Africa, 1998) at its heart, is based on decentralised and participatory water governance.

Capacity, in terms of skills, is another area with two evident contradictions. The activity system makes provision for capacity building through its incorporation in each project, according to the *rules* of RDM determination and implementation. But it has not been achieved. Where the DWS does not have the necessary scientific capacity for RDM execution in-house, it outsources these projects to external scientists, with the requirement that they ought to ensure skills transfer to DWS staff members (see Section 6.3.1.2). Firstly, the outsourcing results in a failure to develop internal capacity (see Section 6.4.1.2 [a]), although it does result in much learning among the external science teams. This appears as a *double bind* and a *dilemma*. If DWS outsources the work, it does not build the capacity itself. If it does not outsource, the work cannot be done in-house.

Secondly, measures are in place to ensure the transfer of skills and know-how in RDM determination and implementation. This does, however, not happen due to disconnections in the system, such as a lack of institutional support for building capacity through needs assessment and practical capacity building programmes. Others include lack of *tools*, such as models for example, to ensure effective execution of the work, and limited financial resourcing, through budget cuts for capacity building, participation in field trips, and attending CMFs. While training attendance is recorded, it does not seem to be informed by learning needs assessment, customised curricula, or assessment and evaluation. None of these activities, vital for effective capacity-building, have been recorded. A fundamental contradiction is in the expectation for consulting teams to facilitate capacity building in the context of being vested in their own business continuity. Historically, the institution has not formed teams with all required areas of specialisation, per unit or functional area. All Classes, Reserve and RQO studies have been conducted by consulting teams.

Similar to and intertwined with capacity building, stakeholder engagement also appears to be a full *object* in its own right, as these sub-activity systems emerge within the National Office RDM Determination Activity System (see Section 6.4.1.2 [c]). As key requirements in the *rules*

for RDM projects, these two factors have featured prominently across the study in document analysis and role-player experiences. Figure 6.7 below illustrates the emerging sub-activity systems, contributing to the implementation challenges as detailed next.

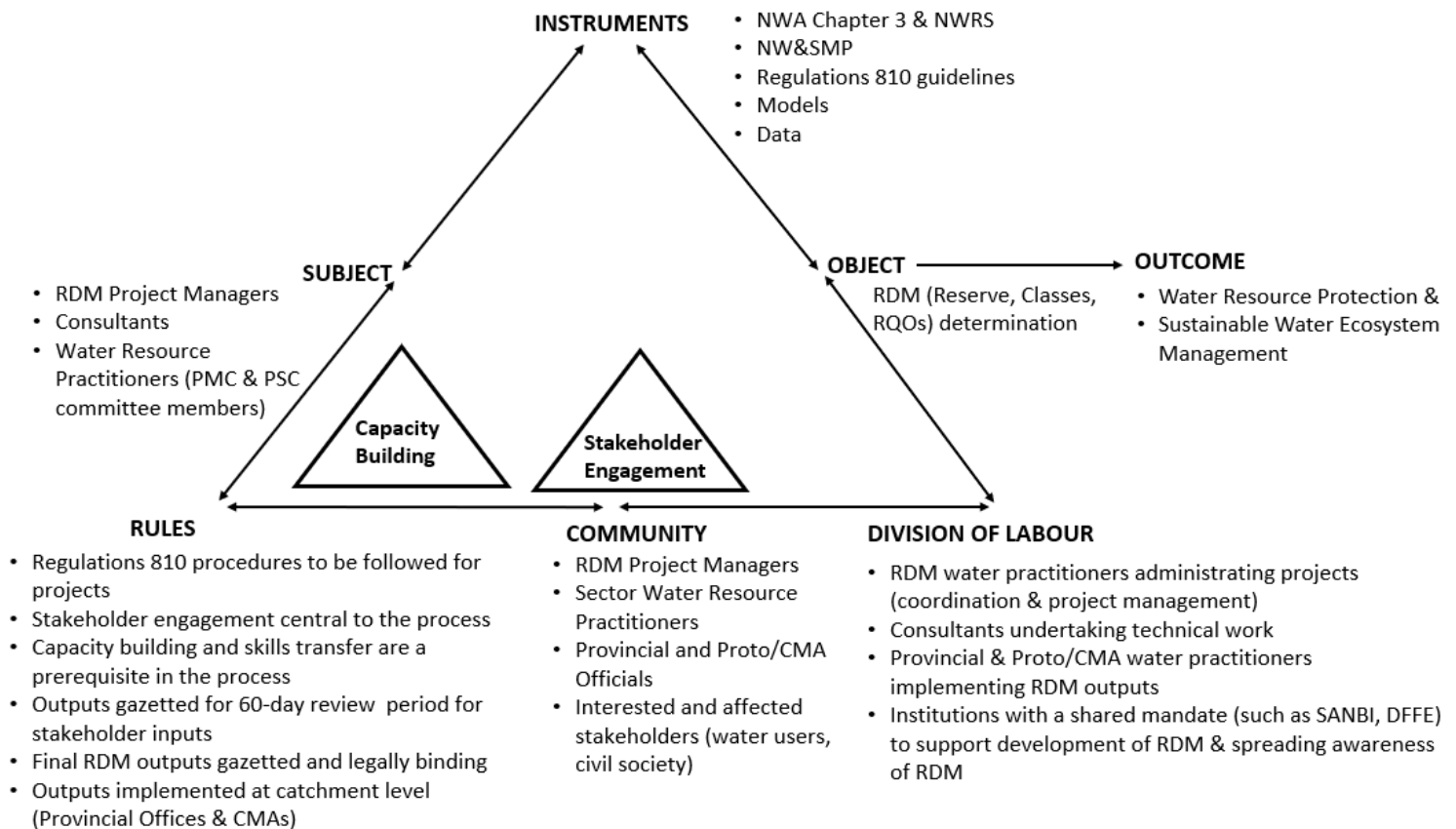


Figure 6.7: Sub-activity systems embedded in the RDM determination activity

Source: Author

Another *dilemma* manifests when the RDM outputs must be applied in implementation. There is not enough understanding among the officials responsible for this implementation, and at this point, the scientists who developed the understanding of the system, are no longer contracted. Moreover, at this point, implementers seem to lack the decision-making platforms, skills and resources to efficiently and effectively allocate water usage, equitably and sustainably in consideration of RDM.

An overall contradiction is in the implementation mandate assigned to regional institutions, not sufficiently resourced, due to the lack of a functional implementation institution. This leads to implementation challenges. In terms of the institutional arrangement and the decentralised management system, the *rules* require implementation at regional level, as detailed above. However, at the time of this study, a functional CMA was not yet established in KZN and the provincial office was functioning as a proto-CMA. Due to this lack of a functional CMA, responsibilities were unclear between the proto-CMA and the provincial office. The manifestation of a contradiction raised by role-players is in the *division of labour* between officials in the provincial office and the proto-CMA, where the *lack of clear roles and responsibilities results in lack of execution of tasks* (AS2.1-RP3 & KZN workshop). The manifestation of a secondary *contradiction* arises in the form of a *conflict of motive*, where limited capacity leads to provincial offices also acting as proto-CMAs without adequate human and financial resources. In the absence of functional CMAs for the majority of catchments, implementation of RDM functions at the local catchment level is compromised, where capacity constrained DWS provincial offices are also functioning as proto-CMAs. This secondary contradiction also emerges between the *instruments* and the *object*, that is, a lack of CMA structures hindering the execution of its intended functions.

As a result, the *critical* challenges and *disturbance* experienced are polluted and degraded water resources, and citizens without water. For officials in the activity systems, this may well generate very difficult *conflicts*. These lead to the question, what are the fundamental contradictions underlying the challenges outlined? Is the intention of the NWA (South Africa, 1998) to provide water both equitably and sustainably, a fundamental contradiction that is impossible to solve? Or is the level of resourcing, through budgets and personnel, simply inadequate? Perhaps the framing of the problem is to blame? Why are the measures for learning and capacity building, that have been put in place, not more effective? The expansive learning methodology developed by Engeström (2001), Engeström and Sannino (2010), Mukute (2010), Lindley (2014), Lotz-Sisitka, Wals, Kronlid and McGarry (2015), Pesanayi (2018), and others, point to several ways in which role-players can engage with the manifestations of contradictions to transform and develop activity systems beyond current stalemates.

On the other hand, Foot (2014, p. 22) explains that

the source or trigger of change that precipitates a secondary contradiction within the activity system could also be external to the central activity system (control of costs or budget cuts). Regardless of the source, the pressure of this aggravated contradiction might lead the organisation to rethink their practice to alleviate the tension it creates.

The need for re-thinking approaches is evident since the Olifants, Vaal and Olifants Doorn RDM Gazettes were among the first and oldest. Yet, to date, there has not been any implementation.

6.5.2 Interlinkages of study activity systems

The National Office RDM determination and KZN RDM implementation activity systems are within one organisation, DWS. The Mpumalanga IUCMA RDM implementation activity system is the catchment implementation arm of DWS. Looking across the selected case study activity systems, I have found interlinkages in these selected activity systems as depicted in Figure 6.8. The National Office RDM determination activity system is situated in the head office within the organisation. Its *object* becomes part of the *object* of the KZN and MP provincial activity systems, as part of the *rule* (as an example, catchment implementation of determined RDM) in the organisational structural arrangement.

The interlinkages found in these activity systems stem from the shared *outcome* of water resource protection and shared *object* of providing *some, for all, forever* (South Africa. DWAF, 1997), drawing down from the mandate of their macro-environment.

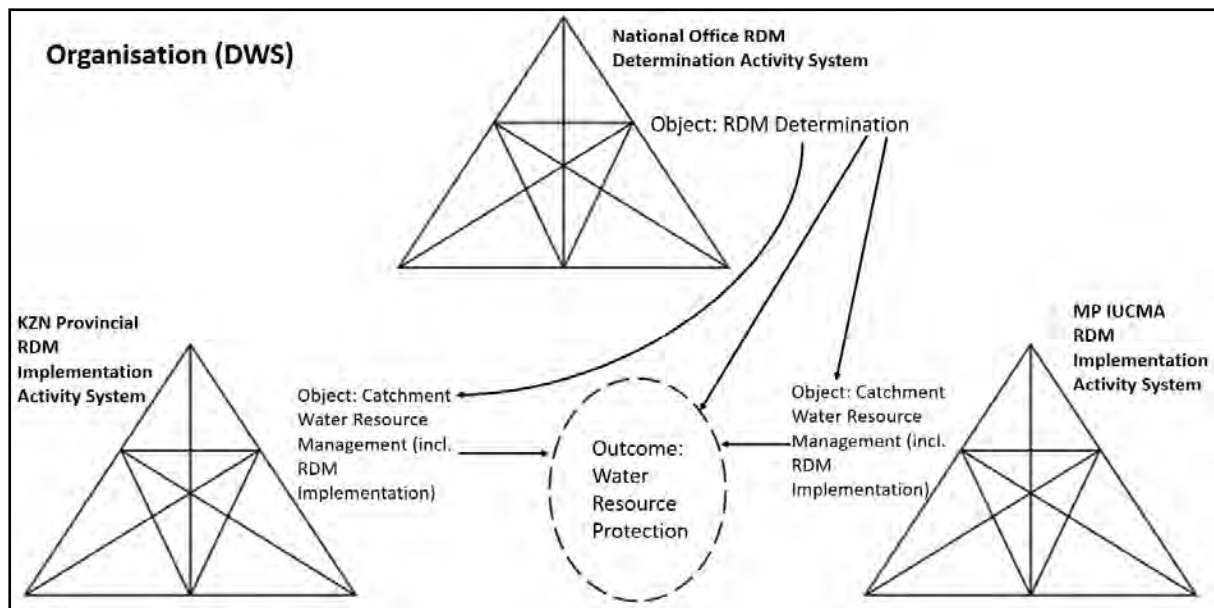


Figure 6.8: Interlinkages of study RDM activity systems

Source: Author

Figure 6.8 depicts the interlinkages between the different activity systems in terms of their organisational positioning, demonstrating the shared *outcome* of water resource protection. Interlinkages between the activity systems are borne from the functional mandate of the organisation, inscribed in the *rule* that the main functions at the national office level are the development of policies, guidelines and strategies. At the provincial level the main function is implementation of the national office outputs. The study has shown that this separation of functions, that are in fact interlinked, presents various challenges during RDM implementation (see Sections 5.4.12 & 7.4.3). This includes insufficient support and a lack of functional units and expertise to conduct work. In essence, factors emerging in the head office level activity system cascade to the provincial office activity systems, and ultimately manifest in the form of *tensions* and other contradictions.

Internally within DWS, factors from other DWS units impact and contribute to the selected case studies' activity systems. To demonstrate this interlinkage finding, units responsible for data, water resource planning, and other functions, play a key role in the RDM practice.. For example, the lack of a data storage tool at the national office hinders the availability of raw data for future RDM assessments, and this would in turn hinder future planning.

Externally in the water sector, institutions with a shared mandate play a significant role in supporting RDM projects, such as providing input data, and contributing towards overall water resource protection. Figure 6.9 depicts these interlinkages internally, within DWS, and externally, in the sector with the shared *object* of water resource protection, evident.

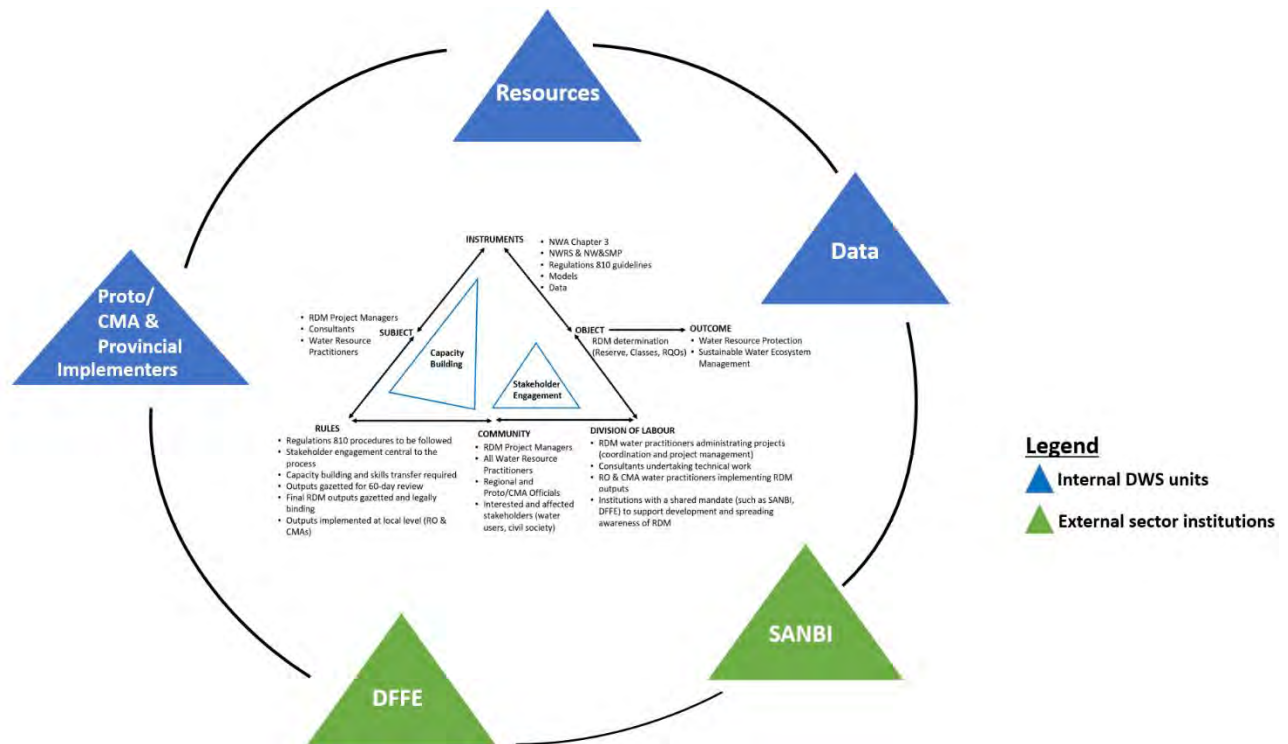


Figure 6.9: Activity systems embedded and interlinked to the RDM determination activity system

Source: Author

Looking across all the activity systems, I have found interlinkages that reveal possibilities for the kind of organisational learning described in the third generation of CHAT (see Section 2.4.3.2), that of expansive learning where role-players from two or more activity systems with partially shared objects could engage in collective activity (multi-activity collaboration) to transform components of the activity system and generate a new shared object and concept for their shared activity (Engeström & Sannino, 2010). Engeström (2001) explained that the third generation of activity theory takes two interacting activity systems as the minimal unit of analysis, inviting researchers to focus efforts on the challenges and possibilities of inter-organisational learning.

Figure 6.9 also illustrates that the National Office RDM determination activity system contains other embedded activity systems, such as those for capacity building and stakeholder engagement. It also interlinks with various internal and external activity systems with a shared *object*, demonstrating expansive learning possibilities. An explanation for this is articulated by Virkkunen and Kuutti (2000, p. 301) who indicated that “the key element of an activity system is the object of that activity”, meaning, its purpose which can be shared by the participants of the activity who could manipulate or transform it because the object is the societal motive of the activity and it defines the activity and separates it from other activities. In essence, the outcome of an activity can become a part of another activity system, such as an *object* to be further transformed in the value chain, a *subject* (the outcome of a training activity), a *tool*, or a *rule*. These authors explained that there is always a network of functionally linked activity systems; whereby the links between activity systems are determined by the objects and outcomes of the activities in the network (Virkkunen & Kuutti, 2000).

6.6 CONCLUSION

Viewing RDM determination at the national, provincial and CMA levels as activity systems through a CHAT lens, provides a view of the factors at play in each node, and the interactions between these nodes, helping to identify a number of both primary and secondary contradictions and thus rendering them up for analysis and further learning. These contradictions will be discussed further in Chapter 7.

Interlinkages were found in the selected activity systems as depicted in Figure 6.8, due to the shared *outcome* of water resource protection; where the National Office is responsible for RDM determination and the KZN and Mpumalanga provincial offices are responsible for implementing the RDM outputs for their respective Provinces. Hence, factors emerging in the head office level activity system cascade to the provincial office activity systems, and ultimately manifest in the form of *tensions* and other contradictions. Moreover, interlinkages exist internally, within DWS, and externally, in the sector due the shared *outcome* of water ecosystem management, demonstrating opportunities for integration, co-learning and leveraging strengths between units and across sector organisations.

An overall contradiction between the *object* of National Office RDM determination activity system and *rules* of the provincial implementation activity systems was evident as a driver of manifestations of contradictions, due to the highlighted interlinkage between these activity systems. The institutional arrangement is such that implementation of RDM outputs takes place at provincial level. A contradiction between these activity systems emerged due to human resource and budgetary capacity constraints in provincial offices, where there are no functional CMAs, and these offices have to function as proto-CMAs. Such a contradiction between the activity systems suggests transformative potential that calls for collaborative envisioning and deliberate collective change efforts.

7. CHAPTER SEVEN: SYNTHESIS OF FINDINGS AND RECOMMENDATIONS

7.1 INTRODUCTION

This study was premised on the assumption that surfacing learnings from Resource Directed Measures (RDM) interventions would be valuable for strengthening organisational capacity to improve future implementation. Based on my engagement with both historical documents and current role-players, these learnings seem key to enhancing the efficiency and effectiveness of implementation projects and informing organisational decision-making. This chapter addresses the third research question: *What lessons and recommendations can be drawn from past RDM interventions for policy implementation, and overall organisational learning?* As part of Phase 3, this chapter provides a synthesis of analytic findings to consolidate key emerging thematic areas including the challenge of providing *some, for all, forever*; decentralisation; resources: tools, financial and human resources; data; capacity building; stakeholder engagement; and the RDM implementation challenge. These themes emerged from Phases 1 and 2 (see Chapters 4 & 5) as major systemic factors for organisational learning. Here the emerging themes are organised according to the three broad levels of objective 1, namely policy, institutional and operational categories; and discussed under sub-headings cultural historical context; social learning activity systems, contradictions and causal mechanisms; findings and their significance for organisational learning; and recommendations (see Sections 7.2 to 7.5). This chapter seeks to derive learnings from the past ten years of RDM implementation, as an organisational learning case study on water ecosystems management in South Africa.

In Sections 7.2 to 7.4, I employ the Cultural Historical Activity Theory (CHAT, see Section 2.4.3.1) to surface underlying contradictions (see Chapter 6), identified through discursive manifestations, and possible causal mechanisms emerging from retroductive analysis (see Section 3.5.4) with a critical realism lens (see Section 2.4.5). Through the logic of critical realism (see Sections 2.4.5 & 3.5.4), I identify the underlying conditions through which to probe more deeply the known challenges of a Complex Social-Ecological System (CSES, see Section 2.2.3) presented by this study as comprising of multiple overlapping activity systems. These conditions were identified through document analysis (see Chapter 4) and role-players' shared experiences (see Chapter 5), so that new understanding and knowledge are generated towards possible explanations for contradictions (see Chapter 6). I also identified existing organisational learnings using a social learning lens. The critical realism lens provided a tool for illuminating the causal mechanisms of the contradictions, in relation to the study objectives. I aimed to unearth and bring to the surface the reality, otherwise not necessarily visible at the empirical level and not known before. Each section below is concluded with a consolidation of

findings per emerging thematic area, to draw lessons from past RDM interventions, and generate recommendations to guide future policy implementation and advance organisational learning for water resource protection and management.

7.2 EMERGING THEME IN THE POLICY CATEGORY

7.2.1 The challenge of providing *some, for all, forever*

7.2.1.1 Cultural historical context

A historical view of water management in South Africa is detailed in Section 2.3.1.1. Pre-1994 water management in South Africa was under the 1956 Water Act, Act 54 of 1956, which tied people's right to use water to riparian land ownership. As a consequence of inequitable land ownership during the discriminatory apartheid regime (see Section 2.3.1.1), the Water Law Review Panel (WLRP, 1996) reported that water rights and access were racially skewed against the majority.

After the 1994 democratic election, policy review processes abolished riparian water ownership, and afforded water rights in line with the Constitution of the Republic of South Africa (South Africa, 1996). Equitable access, sustainability, and full state management by the Department of Water and Sanitation (DWS) were among the core principles (see Section 2.3.1.2). The National Water Act 36 of 1998 (hereafter the NWA; South Africa, 1998) enshrines these principles. Through it the country embarked on a water reform process that aimed to balance socio-economic and environmental development, in its quest to achieve *some, for all, forever* (South Africa. DWAF, 1997) introduced in Section 2.3.1.2. The DWS, as the only custodian for water resource management, has the challenging task of sustainably managing a precious resource, for the benefit of all South Africans.

Relevant to this study, the purpose of the NWA (South Africa, 1998) is, inter alia:

- to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account:
 - meeting the basic human needs of present and future generations;
- promoting equitable access to water;
- redressing the results of past racial and gender discrimination;

- promoting the efficient, sustainable and beneficial use of water in the public interest;
- facilitating social and economic development;
- providing for growing demand for water use;
- protecting aquatic and associated ecosystems and their biological diversity;
- reducing and preventing pollution and degradation of water resources. (South Africa, 1998, p. 18)

These intentions of the NWA (South Africa, 1998) form the core of the mandate of the DWS, and its Water Ecosystems Management (WEM) Chief Directorate, to develop and implement measures for protection and conservation of water resources. As detailed in Section 1.5, determination and implementation of RDM for water resource protection is a practice within the broader context of water resource management. This recap of the background contextualises RDM determination and implementation in the cultural-historical context of the DWS, as its broader macro-environment.

7.2.1.2 Social learning activity systems, contradictions and causal mechanisms

Provision of *some, for all, forever* (South Africa. DWAF, 1997) requires sustainability as a goal in the management of water resources and ensuring a balance between water resources protection and use. The mandate for water resource protection through RDM is stipulated in Chapter 3 of the NWA (South Africa, 1998) which forms part of the *tools* in all the activity systems mapped for this study (see Chapter 6). This legislative tool further informed the development of the Regulations 810 (South Africa. DWA, 2010), and the National Water Resource Strategies 1, 2 and 3 (South Africa. DWAF, 2004 & 2013; DWS, 2023), all of which provide guidance for RDM determination, and also serving as *tools* in the activity systems (see Section 6.2). The intended *outcome* of RDM is to achieve a balance between water resource protection, on the one hand, and socio-economic developmental use for all citizens, on the other. This intended *outcome* manifests as a *double bind*, presented by the equally pressing and contradictory needs for environmental conservation through protection, and socio-economic development through use.

As a researcher, I sought to unearth possible causal mechanisms driving contradictions around the water *object*, particularly the need to balance protection and use to achieve *some, for all, forever*. Section 7.2.1.1 provides the cultural historical context in the macro-environment of the study. Water resource protection forms part of the NWA (South Africa, 1998) specification in Chapter 3 through RDM, aimed at ensuring a balance between protection and use. Past injustices of the apartheid policies included inequitable access to water, where water was allocated to a selected few and used extensively for economic development (see Section 2.3.1.1). The *double bind* presented by the equally pressing and contradictory needs for environmental conservation and socio-economic development was therefore skewed towards economic development promoted by past policies, a trajectory which according to Funke led to severe degradation (see Section 2.3.1), a threat to water security (see Section 1.2.1).

In addition, the shift in the *object* of the NWA (South Africa, 1998), to provide *some, for all, forever* was faced with challenges of redressing past injustices. As part of the transformation agenda post 1994, the government initiated processes for reviewing water policy and legislation. It put in place new laws focused on equity, sustainability and efficiency through the NWA (South Africa, 1998) and Water Services Act 108 of 1997 (South Africa, 1997). Lotz-Sisitka, Rosenberg and Ramsarup (2021) described how, since 1990, South Africa has been undergoing what they expressed as a complex and paradoxical transformation process; reflecting a massive shift from the apartheid state that excluded the majority of the country's people from basic needs such as education, land and water, to a more inclusive society premised on human rights, social justice, sustainable development and transformation. The authors (ibid.) describe a key part of this transformation as being policy review, with the period 1994 to 2000 marked by an influx of new policies with strong ideological imperatives for replacing apartheid state policies. Among these was the NWA (South Africa, 1998). According to Lotz-Sisitka et al. (2021), this was followed by a period of policy implementation ushering in a myriad of new structures, often without the agency, knowledge and other resources to carry through ambitious policy intentions. This led to various policy revisions and eventually, implementation fatigue. In the case of RDM, the policy revision mandated DWS to put a Water Resource Classification System (WRCS) in place to specify the step-by-step

guideline for conducting RDM (see Table 2.3 & Section 2.3.1.4). An ambitious undertaking while simultaneously water use authorisations were underway. Therefore, pre-liminary Reserves (defined in Section 2.3.1.4) had to be conducted for water use authorisations that were considered before the WRCS as a guideline was in place. This study found that in project areas where one component of RDM was determined in the past (such as pre-liminary Reserves), this information first needed to be updated. Subsequently, with more learnings and knowledge in the system, greater efficiency was observed where integrated projects were executed. In a nutshell, policy reforms post 1994 were ambitious and far-reaching. It was not easy to implement them as evidence in the implementation fatigue described by Lotz-Sisitka et al. (2021) but with learning, implementation improved. An example of improvement being integrated projects where the various components of RDM were all being determined at the same time.

Within the study context, policy revisions are continuing with the amendment of legislative *tools*. The DWS National Water Amendment Bill (South Africa, 2023) and the Water Service Amendment Bill (South Africa, 2023b) are currently underway. At a public consultation held in February 2024 (DWS, 2024b), officials explained that these amendment bills are learning examples informed by practical experiences in the last few years of water resource management. These reviews aim to make changes to better position water legislation to redress past discrimination and ensure equitable water allocation. Therefore, bringing the intended transformation, more effectively, to water service delivery, and ensuring water resource protection. In the RDM context, the amendment provision included is an example of learning as explained by AS1.1-RP10 that *the Amendment Bill incorporates the review of RDM outputs and specifies some time frames. This is a lesson learnt, brought about by stakeholders during various project meetings and consultations*, see Sections 5.4.2 and 6.4.1.1 (b).

In the RDM activity system, role-players have for some time identified the need for improvements in the tools and rules, such as, the stipulation of a review period to enable revisions, and clarifying the definition of ‘significant water resource’, which previously excluded dams in the manner in which the existing definition was interpreted (see Section

5.4.12). Some of these factors are the legacy of the previous political regime, elaborated in Rosenberg, Ramsarup, Gumede and Lotz-Sisitka (2016, p. 2) in:

The previous government commissioned dams and inter-basin transfer schemes that benefitted white settlements and commercial farmers. Such engineering solutions have created new ecological and farming problems (e.g. black fly), and discriminated against the former homelands and subsistence farmers, who seldom benefited from the consequences of water being redirected to the privileged few. Dams and transfer schemes are not sustainable. All our major rivers have already been dammed, but not all households have access to water, and the South African Constitution (South Africa, 1996) compels us to share water with all, more widely and more equitably.

Given the variable rainfall pattern in the country, dams have been retained to serve as an engineering solution for storing water during high rain seasons and to provide water during dry periods. Their storage capacity is used to achieve long term basic water access and economic use. Currently, the extent of damming rivers takes into consideration the natural hydrology, size of dams, land use and intended storage, on a case-by-case basis, intended to balance ecological protection and water supply needs. However, there were no explicit RDM stipulations for these structures to ensure management of environmental impacts in the past due to their exclusion in projects.

In the current policy revision of the DWS National Water Amendment Bill (South Africa, 2023), a review period is stipulated for RDM processes. Although the inclusion of dams as a significant water resource is not covered in this process, RDM projects have started including these in recent years, a change that indicates learning in the activity system.

Another related change is the revision of Regulation 810 procedures (South Africa. DWA, 2010) to align similar steps across the RDM components (see Appendix 1), together with a revision of terminology, such as, Management Class to Water Resource Class, as an example.

This demonstrates how the policy context for water resource management in South Africa is complex, exacerbated by constant changes informed by the practical situations. According to Ison and Watson (2007) such a situation exemplifies policy as a process, whereby common circumstances are those where policy is designed to change a given situation but the situation is often found to be changing anyway and giving rise to changing pressures for changes in policy.

7.2.1.3 Findings and their significance for organisational learning

Over time, the democratic government's transformative water *object, some, for all, forever* (South Africa. DWAF, 1997) has proven challenging due to a host of factors that became evident in this study, summarised next.

In the RDM context, a fundamental contradiction was found in the dual mandate to balance water resource protection and use. Challenges to meet this dual mandate are observed on the ground in water resource degradation and insufficient access to water (see Section 1.2.2). Several contributing policy and legislative factors were found in this study. Firstly, there is a need for the explicit specification of a review period in the RDM process, given that the outputs are gazetted and become legally binding. This need for a review period for gazetted RDM outputs has been prominently raised by role-players based on experiences in previous RDM determination projects (see Sections 4.2.1.2, 4.3.2, 5.4.2 & 6.4.1.1 [b]), hence this study found the inclusion of a review period in the policy amendment process to demonstrate learning in the system. Secondly, the need for a clearer definition of 'significant' water resources to include dams, excluded in earlier RDM projects (see Section 5.4.12). The addition of these engineered, man-made water resources in decision-making is significant; because if not managed, they pose a detrimental risk to ecological functioning. Thirdly, role-players across all the engagements in this study called for integrated approaches. The recent integration of RDM projects for determining Classes, Reserves and Resource Quality Objectives (RQOs) concurrently, was found to be more efficient for aligning and cross-pollinating approaches. Role-players found integration to address inefficiencies through, for example, the elimination of lag periods for updating information (see Sections 4.2.1.2, 4.4 & 5.5).

In summary, the amendment of water legislative *tools* underway at the time of the study included, among other changes, a review period for RDM. This is an important indication of implementation learning feeding back into the organisational system, reflected in sector-wide stakeholder input. In addition, the inclusion of dams in recent RDM projects and integration of Class, Reserve and RQOs project processes signify organisational learning.

7.2.1.4 Recommendations

Navigating the tension between provisioning water, equitably for all, while protecting water resources, supporting development and meeting multiple, often conflicting, water user needs, involves multi-institutional collaborations. Execution of this mandate has to consider sustainability and the integration of social and ecological systems during decision-making in water resource management activities. This includes RDM determination and implementation. These processes are thus complex.

Given the critical need for effective water resource protection measures and sustainable water use, policy revisions must clarify grey areas, fill gaps and explicate ambivalences. It must address practical implementation challenges. This implies that policy revisions need not 'set aside' the intention to protect water resources. Ongoing learning is needed to fulfil the inherently contradictory, but nonetheless necessary dual purpose of sustainable water resource protection. Learning should enable and be further informed by reflexive, adaptive management processes, to allow for iterative co-learning among role-players and revisions of approaches that embrace and respond to the inherent complexity of social-ecological systems.

7.3 EMERGING THEMES IN THE INSTITUTIONAL CATEGORY

7.3.1 Decentralisation

7.3.1.1 Cultural historical context

Chapter 7, Section 156 of the Constitution of the Republic of South Africa (South Africa, 1996) stipulates that functions should be delegated to the lowest appropriate level, for example, local government, provided the local entity has the capacity to administer it. This calls for the separation of roles and responsibilities, where possible. Legislatively, the intended decentralisation of water resource management calls for the establishment of Catchment Management Agencies (CMAs) for local implementation at a catchment level. Since 1998, this decentralisation saw the initial demarcation of 19 Water Management Areas (WMAs) with their boundaries defined in Government Notice No. 1160 of October 1999 (South Africa, DWAF, 2004). This government notice (*ibid.*) also defined where CMAs would be established. However, as table 1.3 demonstrates, WMA demarcations have been shifting considerably, decreasing with each revision over the years. This would appear to be contrary to the intention of decentralisation, moving more towards centralisation. Moreover, to date, South Africa only has two functional CMAs, namely the Inkomati Usuthu Catchment Management Agency (IUCMA) and the Breede Gouritz CMA (BGCMA).

In 2023, the DWS embarked on finalising the establishment of six CMAs to align to the revised six WMAs published in the NWRS 3 (South Africa. DWS, 2023) (see Table 1.1). At the time of writing this thesis, a consultation process was underway, with organised labour and affected employees, to explore approaches for transferring to CMAs or to retain them within the DWS provincial offices. Transfer agreements were being finalised with trade unions, in accordance with provisions of Section 197 of the Labour Relations Act, Act 66 of 1995 (South Africa, 1995) with emphasis on safeguarding employment conditions, length of service and job security.

7.3.1.2 Social learning activity systems, contradictions and causal mechanisms

At the local level, provincial implementation is highly dependent on functional CMAs, as key institutional *tools* for executing water management functions. Local stakeholder engagement structures, such as Catchment Management Forums (CMFs) within CMAs, are key to providing platforms for addressing local RDM challenges. These forums are also key to ensuring

broader, decentralised water resource management and the execution of related functions. These institutions, when functional, facilitate the development of a Catchment Management Strategy (CMS), a key *tool* for water resource management in a catchment. Both the CMA and CMS are institutional *tools* for enabling local RDM implementation. In the *rules* and *division of labour* of the activity system, RDM implementation is delegated to the responsibility of the Provincial Office, with the National Office providing support, where necessary.

A contradiction exists in the form of a *tension*, where implementers assigned to execute RDM outputs at a catchment level, are constrained by various challenges. In many cases these include a lack of functional institutions, not only CMAs, but also restructured units that are not functioning adequately. Siddle and Koelble (2016) observed that South Africa adopted an extremely complex and sophisticated water management framework. It reflects all the characteristics of a decentralised system. However, local government, one of the key implementers to which responsibility is devolved, faces many challenges, in most cases, among others, inadequate resources. This, in turn, manifests discursively in the form of *conflict* among Proto-CMA and Provincial Office role-players with their counterparts in the National Office, in terms of roles and responsibilities in the *division of labour* node in the activity systems (see Chapter 6).

Over the years, gaps in the development of functional CMAs have delayed implementation of RDM outputs and other water resource management actions at catchment level. CMA establishment was meant to provide a localised structure to prioritise the development of a CMS at catchment level, for cooperative governance, and to facilitate community participation, as well as the coordination of activities to ensure sustainable water use (South Africa, 1998). The CMA structures are intended to have governing boards, established by the Minister, and that are representative of all stakeholders affected by water use activities. The governing board should appoint a chief executive officer (CEO) for the day-to-day running of the CMA (South Africa. WRC, 2006).

The delays in CMA establishment are intertwined with the apparent indecisiveness regarding the number of WMAs to be established. As outlined in table 1.3, over the years the number

of WMAs have decreased from 19 to nine and currently stands on six (intended) with only two having been established and functioning. Bourblanc and Blanchon (2013, p. 2388) noted that at the time, officially, DWA policy documents attributed this to “too small and therefore too many CMAs having to report to DWA would make the situation unmanageable, in addition to the financial cost of such a solution”. This implies that the institution is moving towards geographically bigger WMAs to save costs and for ease of management. The Water Research Commission (WRC), among others, have investigated the challenges of CMA establishment. Among the factors found by Stuart-Hill and Meissner (2018) were issues of administration and mismanagement, skills shortages, inter-basin transfers and power struggles between CMAs and DWS. Hydrologically, the natural boundaries of catchments have been used for informing WMAs. Bourblanc and Blanchon (2013, p. 2388) indicated that a WMA represents the “territory” that a CMA is responsible for. Stuart-Hill and Meissner (2018) point out that WMA boundaries may or may not overlap with political boundaries and water use may differ between different areas. Therefore, the geo-physical catchment as the natural water management unit may not always be suitable.

Bourblanc and Blanchon (2013) conducted a study on the historical background and socio-political aspects of South African water management policy. It focused on the failure of implementation of CMAs, using document sources and semi-structured interviews with stakeholders participating in catchment management fora, CMA staff, the then DWA officials and provincial political representatives. These authors (ibid.) observed that, the then Department of Water Affairs (DWA, now DWS), was reluctant to delegate the responsibility for water resources management to CMAs, so that it could contain big stakeholders from usurping its authority. They (ibid.) further indicated that, although the CMAs will remain formally under the authority of DWA, once declared the ‘responsible authority’ and functions are fully delegated, these institutions and their functions will have great significance, including the “ability to authorise, license and regulate water use” in the WMA (Bourblanc & Blanchon, 2013, p. 2388). From this, a picture of power dynamics emerges, between the roles and responsibilities, and the institutional power, for regulating water resources. Bourblanc and Blanchon (2013) alluded to these power dynamics playing a role in the delay of establishing local water resource management institutions. Given the political history of

water management in the country, the undertone of this causal mechanism comes as no surprise. The lack of a functional CMA in KZN resulted in the duplication of the Provincial Office into also a Proto-CMA, leading to the blurring of roles and responsibilities among staff and ultimately compromising execution of tasks.

Secondly, at the time of writing this thesis, the CMA development process was underway, with CMAs to be developed in alignment within the six new WMAs (see Table 1.1). Evidently, there are challenges in decision-making about the number of CMAs needed, at the local scale.

7.3.1.3 Findings and their significance for organisational learning

Although, it would seem, strides for establishing CMAs are now visible, gazetted for establishment in 2023 and appointment of boards in 2024, role-players advise caution in assuming that challenges at local and provincial level will be resolved. This is not the first time the establishment of these CMAs is attempted. Role-players asserted that these structural changes would take time to function optimally. In the meantime, during the transition, confusion over roles and responsibilities still prevail. These proposed new structures were also found to displace key functions that feed into RDM projects, such as, water quality. This is a critical function of CMAs, but role-players were unclear about where the function resides in the new organisational structure, posing a risk for future availability of data for RDM projects.

Moreover, implementing RDM requires mobilising formal institutional *tools*, such as the CMS. Inclusion of RDM in such a formal strategy will ensure commitment of resources for its implementation. However, for this to be possible, a functional government structure, such as a CMA, should be put in place to draft a CMS and ensure the implementation of strategic water resource management actions.

Functional institutions are a prerequisite for the execution of complex tasks, especially where these tasks have some inherent *tensions*. As outlined in Section 7.3.1, these structures also need the ability to learn deeply from implementation efforts. Delegation of implementation

functions to the provincial level, therefore, requires not only functional institutions, but also built-in processes or platforms for learning.

7.3.1.4 Recommendations

Functional institutions should be established for ensuring execution of tasks. In summary, what is needed, is:

- well-designed activity systems at the local, provincial level; with
- clear definitions of roles and responsibilities, and/or mechanisms for role-players to work out or refine roles in practice, as in the case of the IUCMA (see Section 6.3.2.2 [b]);
- consultative processes that are well supported within the organisation and well understood by role-players; and
- platforms and processes for learning, as implementers work out the best ways in which to achieve their challenging dual mandate, of balancing *protection* and *use* of water resources.

7.3.2 Resources: Tools, financial and human resources

7.3.2.1 Cultural historical context

In the execution of job functions, resources needed include *tools*, budgets and staff. *Functional tools are needed to execute the work* (AS1.1-RP7). Shortages of resources have emerged as one of the major limitations for RDM determination and implementation. Working, operational *tools* range from hard equipment, such as computers, field gear and instruments for field measurements at site which generate data on ecological conditions, to soft tools, such as models (see Section 5.4.6). Where data on sites is available or where field work has been conducted on sites, models are used for its assessments and analysis. Over the years, in RDM, the availability of tools has been one of the major gaps for internal execution of the functions.

Financial constraints attributed to cost curtailments year on year have been cited for various changes in the organisational operations, for example, travel restrictions or an inability to fill vacancies. Most recently, guidelines on cost containment were announced by the National

Treasury for the 2023/24 financial year and outlined in the (South Africa. National Treasury, 2023, p. 1) as:

The current fiscal challenges originate mainly from an exceptionally large year-to-date decline in government tax revenue collections (estimated at R22 billion for the first five months of the year) and tighter financial conditions that have constrained government's borrowing programme. These constraints are exacerbated by the wage agreement for the public service, signed in March 2023, which was not accommodated in the Budget Review 2023 and for which claw-back mechanisms have not yielded results that would mitigate potential negative impacts.

This guideline specifically called for postponing the replacement of equipment such as computers and telecommunication equipment, limiting recruitment and travel to essential fieldtrips. DWS has made various changes to adapt and continue functioning, such as conducting meetings virtually where possible, a new practice learnt from adapting to the COVID19 pandemic, and limiting recruitment and travel.

Human resources is another key institutional requirement for executing RDM functions. Historically, various factors have contributed to human resource challenges. These range from high staff turnovers, due at times to rotation within DWS, and more widely in the sector as individuals seek other job opportunities or retire; an inability to fill vacancies with suitably qualified professionals, and financial constraints, detailed above. Institutional changes are an additional causal factor. The overall organisational structure of DWS has been revised a number of times, the latest revision communicated to staff in September 2022 (South Africa. DWS, 2022b). This restructuring process resulted in the migration, re-placement and displacement of staff, in some cases, and created confusion in terms of roles and responsibilities. Linked to this, teams in the various units are affected by these structural changes, as some members get moved to other units. Structural changes evidently result in the interruption of functions. In the KZN Provincial Implementers Activity System (see Section 6.4.2), role-players indicated that it is not clear within the new structure which of the staff

should stay with the provincial office and which should move to the CMA, and how the roles and responsibilities are to be distributed.

Historically, all these resource-related factors, or a combination thereof, have played a significant role in the RDM determination and implementation challenges experienced in the system.

7.3.2.2 Social learning activity systems, contradictions and causal mechanisms

(a) Tools

Through the CHAT (see Section 2.4.3.1) conceptual lens of the study, *tools*, also known as *instruments*, are part of an activity system. In the RDM practice, *tools* encompass all the hard and soft equipment required for job execution as detailed in Section 7.3.2.1. In relation to these tools, role-players indicated the need to develop adaptable models that can be used over time and adapt easily to changing software (see Section 5.4.6).

(b) Financial

Funding is part of the *tools* in all the activity systems in this study. This is part of financial resources required for the execution of RDM functions. WRC (2020) estimated that R364 million had been spent over a 20-year period on Reserve-related research. This shows that a significant investment is required for RDM projects. Here, the manifestation of a contradiction presents in the form of a *double bind*, where units are placed under cost curtailment (see Section 7.3.2.1) and organisational units are torn between compliance with National Treasury instructions (see Section 7.3.2.1) and the execution of mandated functions.

(c) Human Resources

Human resources in the *subjects* node of the National Office RDM determination activity system include the DWS officials and consulting team members, with their provincial and CMA counterparts participating through project committees. Provincial DWS staff and CMA officials form the *subjects* in the provincial implementation activity systems. These human resources are critical for the execution of RDM tasks. The roles they occupy vary from project

managers, scientists, catchment managers, with specialisations mainly in water quality, hydrology and geohydrology, and control environmental officers (see table 3.3).

In terms of human resources, this study has identified capacity challenges both at the national and provincial office level, for determination and implementation, respectively. These include a shortage in the range of expertise needed for each component of RDM, and the number of staff available. At the National Office, the shortage of the requisite variety of experts within RDM units, who are technically skilled and have the necessary functional *tools* results in continuous outsourcing. This is associated with a manifestation of a contradiction in the form of *tensions* in the *division of labour* between DWS officials and consulting teams, and also between DWS officials involved in determination and implementation. This *tension* appears to arise from the absence of meaningful skills transfer between officials and consulting teams. Role-player insights show that on-the-job learning requires hands-on participation because “people learn as they do” (see Section 5.4.9). This emphasis is also evident in the voice of role-player AS2.1-RP3 who indicated that *internally, it would be great going forward if DWS staff are seconded to work alongside the consultant in their respective areas of interest. You learn by doing. The one or two training gives a broad overview but it is a lot to digest in a short period of time.* The kind of learning that role-players are calling for here resonates with what Glasser (2007, p. 51) termed “active social learning” (see Section 2.4.1), specifically “co-learning”, which “requires team building, complete engagement, learning-by-doing, accountability, in addition to supporting the penetration of existing knowledge, supports the generation of new knowledge and novel strategies for addressing real-world problems”. In this case, the real-world problem is water ecosystems management, through RDM determination and implementation. Role-players also identified the need for working alongside consultants, integration of teams and working with each other in a more complementary manner for mutual benefit. This implied a need for expertise both inside and outside of DWS, to fill gaps and draw from each other’s strengths.

Linked to this, a second manifestation of a contradiction in the form of *inconsistencies* is evident in the variety of skilled personnel within RDM units. The composition of consulting teams that are hired to conduct RDM projects consists of a diverse range of experts (see

Section 6.3.1.2) and a similar diversity was highlighted by role-players in the IUCMA activity system, while this variety of expertise was not the case in the National Office RDM determination activity system. In the IUCMA case study, promising implementation actions are evident. Role-players in the IUCMA activity system indicated that the IUCMA has put in place functional institutional structures for Planning, Water Quality and Quantity and Compliance Monitoring and Enforcement (CME). Role-players indicated that IUCMA teams conducting this work are specialised in hydrology, geology, water quality, habitat and biota, aligned to the components of RDM outputs. These teams meet to integrate observations on the water resources, such as biota responses to hydrological events, for example, and other information.

7.3.2.3 Findings and their significance for organisational learning

(a) Tools

To execute high confidence RDM projects, functional tools, like models and programmes, among others, are needed. Over time updates are effected and these tools, in essence, keep changing. In relation to organisational learning, this study found that the organisation needs adaptable *tools* that respond to changing software that can be used over time to maintain productivity.

(b) Financial

Financially, the study found that manifestations of contradictions are largely *inconsistencies*, where cost cutting measures are implemented while work functions still need to continue. Budget limitations hinder actions and, in many instances, result in ineffective compromise seeking alternatives. In terms of financial causal mechanisms, organisational cost cutting measures often take place in the macro-environment, are government-wide, and administered through the Public Finance Management Act 1 of 1999 (South Africa, 1999). Due to the lack of control over cost curtailment, units have to adapt by finding alternative ways of executing tasks. Unfortunately, some of the changes have resulted in the termination of processes that were effective, such as fieldwork being constrained by reduced travel, and limited practical execution of technical tasks, effective for in-house capacity building through 'learning by doing'. When in-house staff are prevented from participating in activities that

could extend their capacity, there may be an immediate cost-saving, but a longer-term cost as more external expertise need to be hired.

We also see here that budget availability is the key driver for effective execution of water resource management mandates because financial resources also impact on the organisation's ability to fill vacancies and acquire the necessary tools.

(c) Human resources

The structure of units or directorates in DWS is attributed to the human resource challenge. This research study showed that the staffing of these directorates must link with functional mandates or intended outputs.

Therefore, just as a range of human resource specialisations are needed for RDM determination in the National Office RDM determination activity system, the same suite of technical competencies are needed in the provincial RDM implementation activity systems. There is a need for distributed competence within and across these activity systems where multiple forms of expertise are needed within RDM units, both internal to, and extending beyond DWS.

7.3.2.4 Recommendations

DWS must make financial provision for acquiring tools and staff as needs change with time. Its units associated with RDM determination and implementation need to be composed of the variety of competencies and specialisations needed to deliver effective outputs. The organisation clearly has to contend with resource constraints, but in the process needs to weigh up and probe the contradictions that could result in decisions being taken in isolation. It is firstly important to recognise that on-going refinement of tools to adapt and keep up with change is needed as well as the upskilling and reskilling of staff to enable the development of a learning organisation with a complex mandate. However, Mitchell (2013) cautions that this kind of single-loop learning focuses on organisational actions and rectifying its consequences. The author (ibid.) asserted that radical or transformational organisational changes require double-loop learning, focusing on strategic, proactive, generative and frame-breaking

organisational behaviour, rather than behaviours that are operational, reactive, adaptive and frame-taking. This would require building organisational capacity to 'learn how to learn' by, among other things, nurturing open, reflective interactions across the vertical and horizontal structures of the organisation, to help reveal tacit knowledge, and examine underlying assumptions that govern organisational practice. The author (ibid.) reiterates, that in so doing, an organisation learning how to learn would need to know when problems can be effectively solved using single-loop or double-loop learning processes.

In terms of human resources, the range of competencies needed for RDM determination and implementation may necessitate hiring in external skills, lacking in-house. This could also be cost-effective if used effectively as an opportunity to build more in-house capacity. The study suggests that building the necessary capacity requires meaningful, 'learning by doing' participation and that careful thought is given to the nature of 'skills transfer' needed, as well as the monitoring and evaluation of such processes. In line with the learning approaches described by Mitchell (2013), a more meaningful approach to monitoring and evaluation would be needed, one that seeks to inform ongoing organisational learning and the appropriate, single or double-loop learning approach applied depending on the situation.

7.3.3 The data challenge

7.3.3.1 Cultural historical context

The RDM determination process requires a range of data inputs for determination (see Sections 4.2.3.1 [a], 4.2.3.2, 4.3.6 & 5.4.7). This data is sourced from historical records and from various interlinked line functions, internally within DWS and externally, from sector institutions. Depending on the availability of data, RDM Reserve projects can be determined with different levels of confidence ranging from rapid, intermediate or comprehensive. The latter yielding the highest level of confidence. However, as detailed in the Data Management Strategy for Water and Sanitation in South Africa (DWS, 2019), data challenges are systematically experienced in DWS and sector wide. Historically, data management has been a systemic organisational and sector-wide challenge (see Section 5.4.7).

Data challenges in DWS range from a lack of skilled personnel to vandalism of instrumentation, data storage challenges and delays in the procurement of laboratory contracts, among other factors (detailed in Section 5.4.7). At RDM project implementation level, data challenges include a lack of acquisition of data, post projects, and a lack of an RDM data storage system.

7.3.3.2 Social learning activity systems, contradictions and causal mechanisms

Data is part of the *tools* in the National Office RDM Determination Activity System. It is part of the inputs required for RDM determination. Data is acquired from various sources, given the shared mandate on water resource protection with other institutions such as the Department of Forestry, Fisheries and Environment (DFFE) and the South African National Biodiversity Institute (SANBI), to ensure alignment and integration. A manifestation of a contradiction in the form of an *inconsistency* is the lack of a platform for depositing RDM data, post RDM project completion. This is inconsistent with the importance of data as the key input driver in all RDM processes, and for overall informed decision-making in RDM implementation. The lack of a platform for depositing RDM projects data is the leading cause for data being scattered and in the possession of individual project managers and consultants.

7.3.3.3 Findings and their significance for organisational learning

Data is evidently influenced by institutional factors such as availability of tools, budget and human resources for the execution of data management services. The availability of and changes in these tools in turn impact on other operational processes. Over time role-players in the system have realised the importance of data. Evidence of related organisational learning include taking measures to ensure data acquisition, post RDM projects, to address previously experienced challenges due to the absence of a data repository platform. Role-players also attested to having learnt the appropriate format within which they require data for ensuring future use (see Section 5.4.7). As further evidence of learning, an RDM data system is currently under development for storing and sharing data.

7.3.3.4 Recommendations

In this study, secondary data demonstrated the multiple factors involved in data collection, storage and management, which in turn impact on all activity systems. Another social learning study focussing just on data is warranted for further exploration.

7.4 EMERGING THEMES IN THE OPERATIONAL CATEGORY

7.4.1 The capacity building challenge

7.4.1.1 Cultural historical context

Challenges experienced in relation to capacity building, in its full sense explained in Section 2.2.5, appear to be systemic within DWS and across water sector institutions. Capacity building challenges are therefore not unique to RDM determination and implementation. A shortage of technical skills has been identified as one of the contributing factors to the water crisis in South Africa (DWS, 2018). Significant technical skills gaps in key water sector institutions, such as DWS, CMAs, water boards and municipalities, were reported over time by the WRC (South Africa. WRC, 2015) and the Energy and Water Sector Education and Training Authority (EWSETA) in their sector skills plan (EWSETA, 2021), indicating that the issue is ongoing.

Key historic sector strategy documents, such as the NWRS 1 and 2 (South Africa. DWAF, 2004 & South Africa. DWA, 2013, respectively) and the IWQM Strategy (South Africa. DWS, 2017), all cite capacity challenges. Post 1994, the state undertook various organisational measures to attract, enable access, develop and upskill historically disadvantaged groups to ensure organisational transformation. The Broad-based Black Economic Empowerment Act 53 of 2003 (South Africa, 2003) *tools* were utilised to advance economic transformation, and enhance the equitable participation of black people in the South African economy. In this way, a dual transformation human resources strategy was implemented towards a race and gender inclusive staff complement, alongside the environmentally sustainable agenda.

A Human Resources official (see Section 3.4.2.3 [b] & 5.8) shared that in DWS currently, capacity building is largely facilitated externally, through service providers within outsourced RDM projects or HR transversal interventions, consisting of training courses co-ordinated for

interested staff members across the organisation. This is due to a current lack of internal capacity to meet training needs (AS1.1-RP11). This suggests a loss of capacity over time, despite earlier efforts to address capacity issues. As an example, historically, as one of the water quality management initiatives for capacity building, a training committee was in place for overseeing training requirements for personnel. The training committee was based on the philosophy that internal courses should be delivered where in-house experience exists, and only if no expertise is available in-house, should external courses be given (South Africa. DWAF, 2001b). DWS historically ran regular training programmes for water quality officials, resulting in a highly trained cadre of officials. However, over the 2007 to 2017 decade, these training programmes fell away, leaving a shortfall in the opportunities for staff to develop their understanding of IWQM (South Africa. DWS, 2017). The IWQM training was resumed in 2022 and continues up to the present.

An organisational culture of outsourcing developed in DWS over the years. The tasks were now new, and essentially no one had the capacity to do them, because the *object* had shifted. The organisation no longer provided water to a chosen few. The NWA (South Africa, 1998) introduced a new *object* of *some, for all, forever* (South Africa, 1997) and the RDM associated tasks of Classes, Reserve and RQOs determination and implementation were new activities requiring learning by all.

7.4.1.2 Social learning activity systems, contradictions and causal mechanisms

In relation to the National Office RDM determination activity system, capacity building is relevant in relation to various nodes namely the *subjects*, that is, the technical expertise of role-players; functional *tools* for the execution of tasks; and *rules, such as* skills transfer from consultants to officials, as a formal requirement in consulting contracts (see Section 6.3.1.2). The next discussion focusses on the capacity of the RDM role-players.

Manifestations of contradictions that surfaced regarding capacity building for skills ranged from *inconsistencies* to *tensions*. These include how capacity building is logistically executed and ultimately what approaches are used to secure participation. Role-players were of the opinion that where formal education opportunities are available to staff for further

development and learning, such as bursaries for higher education qualifications, they are not always taken up. In other instances where capacity building opportunities exist within RDM projects, in the form of mentorship or skills transfer from consultants to officials, these are not always effective. At a superficial level, the *tension* could be seen to be surfacing in a lack of willingness to learn, emerging from low staff morale or lower commitment to the *object* of the activity system, and a possible lack of willingness or inability among consultants to train effectively. *Tensions* also emerge on the part of the consultant, in the expectation for them to capacitate officials, while their services are inherently a source of income. Building the capacity of departmental officials would be a *conflict* of business interest for them.

Another *tension* is that some believe there is capacity in the system that is just not recognised or trusted, while others believe that there is no capacity in the system. Role-players have highlighted that, in some instances, skills and *tools* are available internally and if consultants do not have required tools and information, they get assisted by DWS to access them. This is evidenced for example where consultants obtain historical and monitoring data from DWS. To this effect, role-players were of the view that the lack of in-house skills is a historical narrative. The contradiction surfacing is the doubt on whether expertise truly exists within the DWS institution or not.

While willingness is a necessity and conflict of interest may be a possibility, a fundamental underlying contradiction found in this study is the overall approach to learning in the system. In Section 7.3.2.2 (c), role-players were referenced who essentially called for an active social learning process of co-learning, and pointed out that they learn by being actively involved in RDM determination and implementation, as opposed to just receiving presentations. Glasser (2007, p. 51) explained that co-learning supports positive change by “building capacity in three fundamental areas: critical evaluation of existing knowledge and problems, knowledge generation and penetration, and application of this new knowledge to policy, practice, and everyday life”. This surfaces a key gap in the RDM capacity building approach. It highlights the need for evaluation of staff’s existing knowledge and challenges prior to capacity building interventions, and for establishing co-learning opportunities (as opposed to only a one-way

transfer of skills) that will encourage cross-pollination of knowledge and application of learning in the RDM practice.

7.4.1.3 Findings and their significance for organisational learning

While there are different understandings of what capacity is among role-players and in DWS, it tends to be associated with technical skills, perhaps for historical reasons associated with the historical *object*, as contextualised in Section 1.2.3. The systemic capacity building challenges found within the DWS institution, were attributed to three sets of factors. Firstly, skills shortages as business processes require multi-disciplinary expertise due to the technical complexity of RDM determination steps specified by Regulations 810 (South Africa. DWA, 2010), hindering internal execution of projects. Secondly, there are institutional capacity challenges, including units not being structured to house all the expertise required in these processes; at times a lack of required in-house tools, such as models; and the absence of functional local institutions, notably CMAs (see Section 7.3.1). Lastly, budgetary constraints as discussed above in Section 7.3.2.2 (b) and 7.3.2.3 (b) add to the capacity challenge. Thus, the capacity challenge is multi-faceted. Capacity for RDM determination and implementation is similarly multi-faceted, not singular, and encompasses a range of skills, from technical to social. In addition, capacity is lost over time, for example, when tools are changed without coordination or when effective data storage platforms are not put in place. Evidence of learning in the system, in this regard, include the initiated RDM Decision Support System (DSS) project intended for RDM information management and a contractual requirement for submission of raw data by consulting teams post projects (see Section 5.4.7). Moreover, human resource capacity is also lost over time due to staff turnover, for various reasons, and unless measures are put in place to counteract this, it could lead to institutional memory loss.

RDM determination and implementation is clearly a complex activity (see Section 2.2.3), and the capacity needed for such an activity is usually distributed across networks. This requires negotiation with others for joint action as explained by Edwards (2011). Additionally, some tasks are unpredictable and may involve responses which could not have been anticipated, and hence flexibility as well as co-learning, as suggested by Glasser (2007). Similarly, Wals, van der Hoeven and Blanken (2009, p. 11) emphasised the need for “learning from each

other” for collective meaning making. Glasser (2007), Wals et al. (2009), and Edwards (2011) all emphasised that this kind of learning is characterised by boundary crossing or horizontal learning, where practitioners must move across boundaries to seek and give help, drawing on horizontal expertise, and to find information and tools wherever they happen to be available. Thus, capacity for complex activities exists in a manner of distributed competence. These findings point to a critical need for co-learning in the activity systems, for the platforms for such co-learning, and the mechanisms to convene the distributed competence. In DWS the mechanisms to convene the distributed competencies effectively are not in place, which could explain why there are different views on whether internal capacity exists, or not: the expertise might exist, but it is not effectively convened in a well-functioning network. Moreover, the activity systems currently do not have platforms for sharing lessons amongst internal role-players, post RDM determination projects. However, role-players found that *in recent years integrated projects on Classification, Reserve and RQOs have provided a platform for learning from each other. There is cross-pollination between RDM processes now, we are learning from each other, and this has created a platform for communication* (see Sections 4.2.1.2, 4.4 & 5.5).

Internally, within DWS, people interact among themselves on how to execute tasks. Where someone has undertaken a similar activity before, staff share with one another and overcome challenges on a peer-to-peer basis (Section 5.4.13). In so doing, social learning on the individual level is taking place and individuals are applying their learnings into the projects they are managing. In this way learnings becoming embedded in the organisational unit. However, role-players found learning in the activity system to be limited to *administrative tasks with technical components being outsourced* (see Section 5.4.9 & 6.4.1.2 [a]).

Organisational capacity encompasses factors beyond individual learning, as depicted in the three layers of capacity in Figure 7.1. Capacity building, particularly skills development, enhances individual learning as individuals participate in learning interactions (see Section 2.4.2), and ultimately organisational learning, once the individual learning feeds back into the organisation, provided there are opportunities to do so. The DWS (South Africa. DWS, 2018 & 2023b) added factors to Figure 7.1 (depicted in blue texts) according to their view of the

organisational setting which constitutes the current study context. The factors initially described by the UNDP (1998) and Matachi (2006) are in black text, while factors emerging from this study are added in purple texts. In addition to factors identified by these authors, this study found that learning at the individual level also requires dedication, capacity to train, and participants willingness to learn. However, such training initiatives ought to take cognisance of the existing capacity in the organisation to avoid a mis-match between the training being offered to staff and their actual learning needs, an issue also identified in the development of the Biodiversity Human Capital Development Strategy (Rosenberg, 2010). Another reason why training might not improve organisational capacity as planned, could be that individuals who have benefited from training might not be able to utilise newly acquired skills if the organisation is not receptive to their application, observed in other contexts by Matachi (2006) and Rosenberg (2010). This implies a need for an enabling institutional environment, a learning organisation, to support the application of acquired skills.

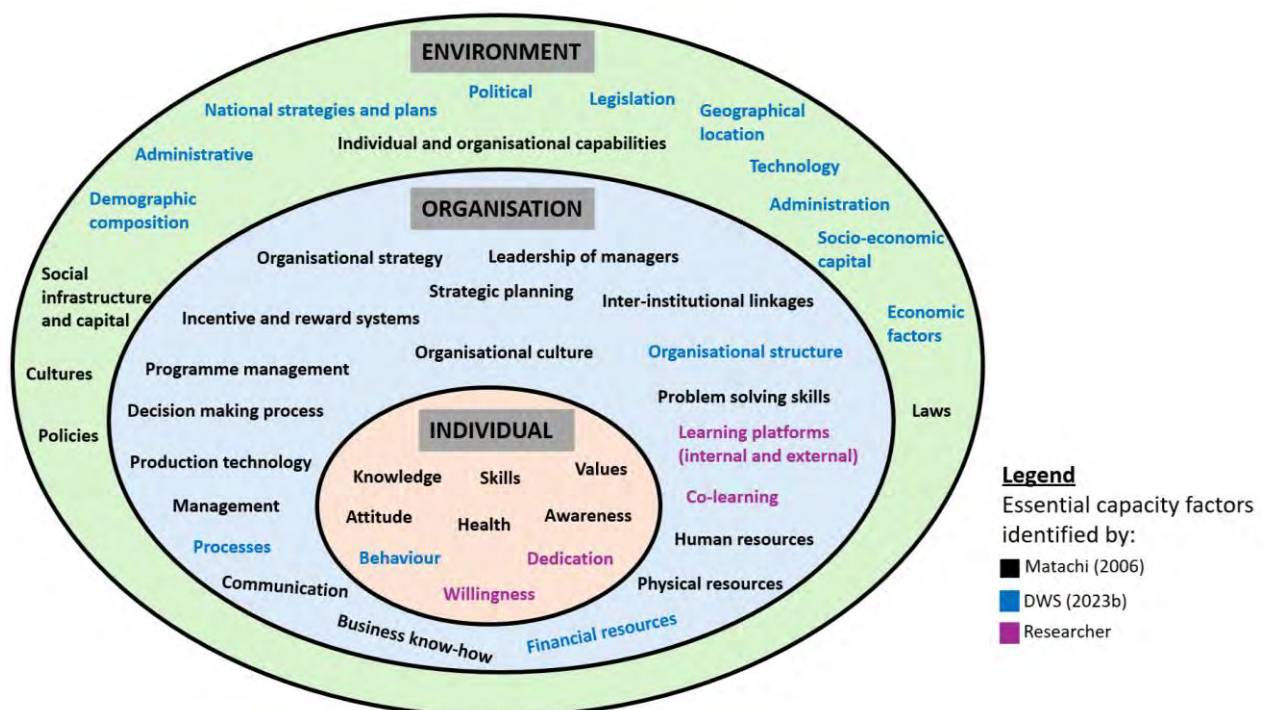


Figure 7.1: Essential capacity factors at each level including emerging study factors

Source: Adapted from UNDP (1998); Matachi (2006); DWS (2018 & 2023b)

Role-players were of the view that available in-house expertise should be identified, and consultants hired only for areas of need, indicating that it is not always an issue of skills lacking, but rather scattered skills, in-house and available within various units (see Section 5.4.9). Role-players engaged in this study were of the view that existing capacity within the National Office RDM determination activity system is not well known or trusted, for all the above reasons. For example, simple tools to assess skills needs in organisational units could be employed, such as the Green Economy Learning Assessment (Partnership for Action on Green Economy, 2016). This framework encourages organisational units to assess not only their technical skills needs but also relational and transformational competences needed. This, among other things, acknowledges that expertise is needed not only to execute a particular task, but to do so with others, and from time to time to also review and refine the task, if needed, pointing to relational and transformational competences, respectively.

Role-players were of the opinion that organisational learning was taking place in the activity systems, and attested to evident project management skills acquired by staff members over time, who learn from each other, through social interactions and sharing experiences on project matters, leading to enhanced understandings of the process. However, learning-by-doing and reflecting seems to be largely taking place in relation to project management, and only in some areas. For example, provincial office and CMA staff do not get much chance for learning-by-doing in the RDM processes, as they are still challenged by its implementation, and associated technical tasks. Moreover, lessons learnt are not optimally harnessed.

In conclusion, my findings suggest that the DWS needs to undertake differentiated outsourcing and convene integrated teams for RDM projects, where consulting teams and officials work together in a more relational manner. Beyond this, as demonstrated in Figure 7.1, the interconnectedness between capacity building at individual and organisational levels within the respective environments must be recognised. As outlined in Section 1.2.5 and above, individual learning might not be effectively utilised if the institutional capacity to do so is not in place. I have also found a number of instances of organisational learning, evidenced for example by changes towards integrating processes for the three components of RDM, higher confidence levels of studies being undertaken (see Section 5.5), and initiatives

to put a Decision Support System in place for RDM data management (see Section 5.4.7). Finally, the organisation is impacted by factors in its macro-environment, for example government cost cutting measures implemented from time to time (see Section 7.3.2.3 [b]).

7.4.1.4 Recommendations

Firstly, capacity building planning and coordination is needed to convene an internal multi-expert team within DWS and externally across sector water resource management institutions to conduct RDM projects through networked activities using distributed competence. This boundary crossing would assist with the evident capacity challenges that exist in units that are not equipped with the multiple areas of expertise needed, and the absence of requisite tools. This will limit the outsourcing of projects, which further erodes organisational capacity, and use contracting only for components where there are no tools to execute them across the partner institutions (detailed in Section 2.3.2).

Secondly, where skills transfer is needed, the study suggests that capacity programmes need to be formalised to define exact training needs, and planned within units to streamline and allocate the necessary budgetary, time and practical resources. Where necessary, capacity building sessions should be included in funded projects for unlocking learning opportunities. Positive examples of successful capacity building and learning were discussed in Section 5.4.9 and form the basis for these recommendations where role-players attested to learning by doing experiences through active participation in projects and initiatives, and hands-on learning through a co-created capacity building plans that recognised participants areas of interest for capacitation. This was coupled with the dedication of participants to learn and the capacity and motivation of consultants to train.

Thirdly, it was found that a platform for information sharing, post projects, is needed (see Sections 5.4.13 & 7.4.1.3), recognising and building on the existing peer-to-peer and cross-pollination processes. This could enhance the ability for practitioners to reflect and learn from their previous experiences. It would encourage them to explore available options and co-generate solutions to their challenges, beyond learning administrative project management

skills from each other. Therefore, more formal learning platforms or processes, such as post-project reflections or sharing of lessons, are recommended.

Currently available staff need to be granted the opportunity to conduct technical work, this could be used to establish the precise areas of deficiencies in skills or tools, among others, and to know which elements need to be outsourced. Where outsourcing is done, it needs to be differentiated to cater only for components not available in-house, and execution should be within integrated teams to ensure cross-pollination.

In summary, recommendations for capacity building are:

- Identify capacity needed organisationally across all the activity system nodes, (such as *tools, subjects, rules, community and division of labour*) to achieve *some, for all, forever*.

Drawing on the extensive experience of the role-players, this study provides a number of pointers in this regard.

- Formalise programmes and make resources, such as tools, time and budgets available for skills development through opportunities for applying learning, to allow staff a platform for conducting technical functions and being hands-on.
- Develop a capacity building plan, that starts by identifying existing capacity in the system, followed by the co-creation of a capacity building plan with participants, important for ensuring their involvement in the identification of skills needs, tailored to individual participants, to enhance ownership and alignment with personal career ambitions. Given the need for distributed competence, also respond to skills needs by function, to ensure that the necessary competencies are in place to execute the RDM function, while at the same time, where possible addressing individual career aspirations. This is a complex human resource development task and needs another form of boundary crossing, between the human resources function in DWS and the strategic managers of technical or functional units.
- Include hands-on capacity building sessions with tangible tasks executed and delivered as part of the project outputs in funded projects, which will be key to unlocking practical learning opportunities and addressing identified skills gaps.

- Use templates to identify skills needs on an ongoing basis, to generate a record and knowledge of existing capacity and skills gaps.
- Create mechanisms for 'lessons learnt' to be surfaced, captured, shared and applied within and across systems, and over time.
- Put protocols in place for when rules or tools need to change, so that capacity development happens alongside these changes in processes.
- Practice differentiated outsourcing where in-house expertise should be identified, and consultants hired only for components of work areas where there are capacity gaps.
- Create platforms for written or verbal inputs for harvesting knowledge to enable and facilitate inter-generational knowledge and sharing as part of succession planning. Organisational learning needs deliberate efforts and structures, for example, reporting templates or recorded feedback sessions, to capture lessons learnt in practice, as practitioners execute their work.

7.4.2 Stakeholder engagement

7.4.2.1 Cultural historical context

As detailed in Section 2.3.1.2, a key feature of the NWA is decentralisation, the delegation of water resource management functions to a provincial level, that enables everyone in the catchment to participate (South Africa, 1998). This is an explicit mandate for participatory water governance at a local, that is catchment level. Stakeholder engagement is a key requirement of the NWA (ibid.).

Guided by this legislation, stakeholder engagement is also a core requirement in RDM determination at National Office, and later during implementation by provincial offices and CMAs. The WRCS guides RDM projects (South Africa. DWAF, 2007) and states that its processes and outputs ought to be generated, jointly with interested and affected stakeholders, through participation and negotiation (see Section 2.2.4). Once RDM outputs, namely Classes, Reserve, and RQOs have been generated, a formal public consultation process is required in the form of a 60-day Gazette, inviting written public comments. This is in line with the Chapter 3 provisions in Section 13(4)(a)(ii) and Section 16(3)(a)(ii) of the NWA, that makes provision for public consultation through a published Government Gazette (South

Africa, 1998). The Minister is obliged to take these public comments into consideration in decision-making processes. Furthermore, the NWA Chapter 14, Section 145 (ibid.) guarantees the public, access to information, meaning that water-related information, in as far as it affects the public, must be made available. This is also in line with the *Batho Pele*, translated from Sesotho to 'people first', principles launched in 1997, as part of transforming the public service culture to prioritising serving all people, equitably (South Africa. Department of Public Service Administration [DPSA], 1997). The *Batho Pele* principles relevant to stakeholder engagement, in this context, include consultation and access to information. Consultation is defined as interaction with, listening to, and learning from people being served. It aims at ensuring that citizens are consulted about the level and quality of public services that they receive and, where possible, be given a choice about the services they are offered (South Africa. DPSA, 1997). In terms of information, the *Batho Pele* principle specifies that citizens should be given full and accurate information about the public services they are entitled to receive. Information should be made available in various languages and formats, including radio, website, newspapers (ibid.).

As described previously in Section 2.3.1.1 and 7.2.1.1, under the apartheid government, access to water was attached to landownership and racially divided. Civil society were not consulted in water management matters (Burt, du Toit & Neves, 2005). In the current dispensation, CMAs are meant to be the responsible authority, and should facilitate effective stakeholder engagement at the local level of water resources management (South Africa. DWA, 2013).

Role-players in this study attested that project managers have been interacting with and seeking inputs and local knowledge from community members and other stakeholders in local catchments, through existing platforms, such as CMFs, in the past. Currently, though, stakeholder consultation is limited to the number of meetings that are scheduled during the project. Due to cost cutting measures, some local level engagements, including CMFs, are attended virtually through online platforms.

7.4.2.2 Social learning activity systems, contradictions and causal mechanisms

Stakeholder engagement is part of the *rules* in all activity systems in this study, as part of the decentralisation and participatory governance requirements of the NWA (South Africa, 1998). Stakeholder engagement is also a means for information generation and sharing. It serves as a platform for obtaining views from interested and affected stakeholders for co-developing projects, inclusively, transparently and fairly, with authorities, like DWS, in this case. Discursive manifestations of contradictions that surfaced regarding stakeholder engagement ranged from *dilemma* to *conflict of motive* and *inconsistencies*.

I found that conceptualisations of how stakeholder engagement ought to be conducted are limited, and where it should be conducted, and under what conditions to accommodate all participants, remain undefined. Role-players, participating in this study, argue that a clear definition of the purpose of these engagements is needed to differentiate between knowledge sharing and stakeholder engagement.

A contradiction manifesting as a *dilemma* was found in the *division of labour* node, where stakeholder consultation is limited to the number of meetings that are scheduled during the project phases in the determination of RDM. Provincial Offices and CMAs are expected by National Office to further conduct stakeholder engagement to consult interested and affected parties through CMFs, as part of their local water governance processes. RDM project managers should, similarly, use these structures to support stakeholder engagement, also meant to assist with clarifying the technical complexity of these processes. Local practitioners experience challenges in cases where they were not part of the RDM project when it was conducted. Even in cases where they have participated in RDM processes, they have found the RDM information too complex, for them to further articulate and share with stakeholders.

This *dilemma* relates at least in part to the challenge that stakeholder engagement, and the extent to which it is conducted, is limited by the availability of budgets. The underlying contradiction lies in the government department *rule* of ensuring participation and negotiation with community members through extensive stakeholder engagement, while, year-on-year, budget curtailments prevail. This hinders RDM officials from continuing past practices of comprehensive stakeholder engagement at CMFs. These budget curtailments

also determine the extent to which stakeholder engagement sessions are included in RDM projects. In addition, due to the reported capacity constraints of too few human resources with too little knowledge and finances, provincial officials find themselves unable to engage stakeholders. Delegation of stakeholder engagement to provincial officials is futile, leading to frustrations and mis-interpretations. Another dimension of this contradiction is that RDM officials do not themselves conduct the technical components of the projects. Their knowledge of the intricate details and rationale shaping the outputs is limited, and engaging stakeholders on this information, is therefore challenging.

Secondly, community stakeholders are regarded as holders of indigenous knowledge and key people interacting with water resources, either positively through protection, or negatively, by polluting water resources or vandalising associated infrastructure. They therefore must be engaged in RDM processes. However, the complexity of these processes hinders their understanding and participation. This presents a *conflict of motive* since the scientific nature of the RDM studies is inherently technical, but to access inputs from these stakeholders, simplification is required. Furthermore, as people interacting with water resources, their understanding of associated protection and conservation measures is key to preventing pollution and its impacts at source.

The above manifestations of contradiction can be elaborated by drawing on Tippet, Searle, Pahl-Wostl and Rees (2005) who, in a European context, explained that deadlines are often tight, resources limited, with ambitious goals and timelines in water resources management. This may lead water managers to speed participatory processes (ibid.). In these contexts, insufficient time and resources are underlying causal mechanisms, limiting stakeholder engagement. Consequences are the resultant inability to continuously engage stakeholders, and ultimately participants feel that they are not being meaningfully involved in decision making. In addition, Tippet, Searle, Pahl-Wostl and Rees (2005) argued that failure to engage a broad range of stakeholders and ensure adequate representation, can lead to decisions seen to be lacking in legitimacy. Technical, financial and resource constraints can also have a negative impact on the ability of stakeholders to remain involved in the process (ibid.).

From the RDM guidelines (South Africa. DWAF, 2007) it is clear that a joint process of knowledge co-production and definition of the underlying norms, among water practitioners, scientists and local water-users, was initially envisaged but has been difficult to achieve. Resource constraints can be the reason, but there is also a need for an understanding of different patterns of knowledge production, defined by Rist et al. (2007), and how best to support the necessary exchanges. Co-learning takes place when “divergent interests, norms, values and constructions of reality meet in an environment that is conducive to meaningful interaction” Wals (2007, p. 39). People learn from each other and build competence as they interface with each other. This was evidenced in the National Office RDM determination activity system where role-players assisted their peers in dealing with challenges (see Section 5.4.13). This learning exchange, driven individually and transpiring organically among role-players, as well as consulting teams sourcing input information for projects from officials, leads me to believe that a formalised forum or platform for sharing learnings could be useful for expansive learning in this activity system. The significance of these learning processes is identified by Lindley (2014, p. 51), that processes of “how social learning takes place is emphasised as being just as important as its outcomes”.

Glasser (2007) described ‘active’ social learning as a form of co-learning which can take place in the context of a conversation, a course or community meeting where attendees raise views, and questions and interactions are promoted in an open, participatory public review process (see Section 2.4.1). The opportunities for cross-pollination and emergence of new solutions make this kind of learning much more effective at creating new practices and sharing innovations than what Glasser (ibid.) terms passive social learning, which would take place by consuming the prior learnings of others. The opportunity to directly engage with a broad range of perspectives has the potential to promote more open, equitable, and competent learning processes.

7.4.2.3 Findings and their significance for organisational learning

Extensive stakeholder engagement is critical at various levels, not only to ensure that important information about water management measures reaches all relevant persons, but also that they participate in knowledge production, standard setting and implementation, during and on completion of RDM projects. This study found that a critical factor is the approach to stakeholder engagement and that the process is neither well understood, nor adequately resourced. As a result, the DWS organisation is missing opportunities to learn from its stakeholders, and vice versa.

As outlined in Section 2.2.4, although policies governing the mandate of DWS are committed to ensuring public participation through stakeholder engagement, DWAF (South Africa. DWAF, 2001) recognised that these policies did not prescribe how, nor the extent of public participation. This omission has led to the development of stakeholder engagement guidelines, to assist these processes. Considering that this realisation was made 23 years ago, the persistence of the stakeholder engagement challenges, found in the study, are unexpected and, hence, systemic. The situation is also not unique to this study's activity systems. In relation to South Africa's 'just transition' away from a coal-based economy, Montmasson-Clair (2023) reported that over time genuine social dialogue has been eroded to become activities that fulfil the *rule* that they must be done, missing the intention of procedural justice, and failing to consider that a just outcome can only emerge from an inclusive genuine process.

At a catchment level, local role-players experience CMF challenges of less active participation of community members and local government counterparts. This is a concerning finding considering that local stakeholders and their knowledge is vital for bringing indigenous knowledge into the process and for empowering community leaders who can influence water resource protection among community members. This challenge leads to the need for local stakeholders to be overtly engaged in RDM processes, to ensure that information is readily provided to implementers on the ground. In concurrence with Young et al. (2014, p. 400), this is important because to understand and act for conservation and sustainable uses of natural

resources “requires transdisciplinary approaches where various disciplines, stakeholders as well as policy makers take part in the co-construction of knowledge”.

To guide a meaningful stakeholder engagement process, the nature and purpose of stakeholder engagement needs to be defined beforehand, such that it can be clear what stakeholders are being asked to participate in, and why. For example, it would be useful to differentiate between knowledge sharing, and knowledge co-creation with people, and to consider purposes such as enabling engagement and people taking ownership of efforts to protect their environment.

A potentially useful *tool* for greater and ongoing learning, with regards to stakeholder engagement, are the Issues and Response Registers (IRRs) which document the matters that arise from previous RDM meetings with stakeholders across all projects (see Section 3.4.1.5). Although the purpose of an IRR might simply have been, or have become, to demonstrate the extent of stakeholder engagement during the project, as a learning tool, the IRR holds much potential. It provides a means for accessing the voice of stakeholders from various backgrounds, including for example, local water resource managers, water users and municipal representatives. IRRs could also be used to identify frequently asked questions, over time, which highlight priority matters of concern in RDM processes. They also provide insights into the DWS response to these issues and how they have been addressed in each project. The IRR document captures a historical footprint of concerns and responses during RDM projects and could be used as a learning tool, that provides institutional memory.

7.4.2.4 Recommendations

Below is a summary of recommendations for stakeholder engagement emerging from the current study.

- Conduct more comprehensive stakeholder engagement, moving beyond project steering meetings and technical workshops, to a community level where water users can participate, to develop RDM with local implementers, NGOs and key stakeholders.
- Involvement of community members during stakeholder engagement stood out as a key need for RDM processes.

- When sharing information, continuously communicate available information, its purpose in various simplified formats to promote understanding, uptake and use.
- Develop tools to support learning on the ground at community level; this could include:
 - Entering into a co-learning process with communities;
 - embracing the notion that learning systems for deriving meaning are different;
 - engaging with things that people value; and
 - ensuring that people are engaged in a manner that has meaning to ultimately ensure water resource protection.
- Ensure knowledge creation ‘withness’ whereby tools are developed with people and not for people, to encourage co-development.
- Revise the public participation guideline to facilitate the sharing of technical RDM project outputs in user-friendly versions, inclusive of a community strategy to communicate in simplified language.

7.4.3 The RDM implementation challenge

7.4.3.1 Cultural historical context

In this study, RDM determination is regarded as the first stage of implementation of the NWA (South Africa, 1998) Chapter 3 mandate on water resource protection by determining Water Resource Classes, the Reserve, and RQOs. The second stage of implementation of the NWA water resource protection mandate implementation of the RDM outputs at catchment level. In this section, a consolidation of findings is presented, demonstrating the historical trajectory of RDM implementation challenges and some learning that happened along the way.

Role-players noted that experiential learning has taken place during the RDM determination stage through the comparison between earlier projects and those conducted in the last five years (see Section 5.4.1). Learning is evident in efforts to address challenges related to outputs formats: Recent *Gazettes* clearly stipulate and include all four characteristics of water courses components which are hydrology (quantity), water quality, habitat and biota (AS1.1-RP3). These elements were not reflected together in past gazettes and could not be easily identified by users (see Section 5.4.1).

Other evidence of learning in response to past challenges is the integration of RDM components in single, as opposed to separate, projects. Role-players have welcomed the integration of RDM project components, describing the value of these as a platform for learning from each other (see Sections 5.5 & 7.4.1.3). They go on to describe the concept of pollination across projects as enabling this learning, increased communication and greater efficiency. Moreover, projects in the past five years have included all water resource types (such as inclusion of dams as detailed in Section 5.4.12) and are conducted at higher levels of confidence than in early years, providing more reliable results for decision making. More evidence of learning is the refinement of terminologies (see Section 5.5) and the testimony of project managers who have experienced learning-by-doing through active participation in projects and initiatives.

Evidently some of the changes were the result of RDM teams responding to what they perceived as challenging circumstances. As an example, in the past, projects were only led by managers in DWS. However, as more projects were being conducted concurrently, the load was shared with scientists. This has led to much learning in the activity system. However, changes over time were also effected in areas of practice that were working well. One such an example is the termination of CMF participation by project managers. The CMF provided a platform for information sharing with stakeholders and skills development for project managers. Project managers were learning by doing, while knowledge was being shared with stakeholders, enabling them to over time interact with the information.

Some challenges also persist over the years. The need for resources (see Section 7.3.2) has been identified and acknowledged as a key requirement for execution of RDM determination. Another critical challenging factor for implementing RDM determination, is capacity, summarised in Section 7.4.1. Much has been done over time to build technical skills for RDM determination through learning workshops in projects, job specific institutional technical training courses, project training through fieldwork, sector event participation, such as conferences, supporting professional development through formal skills development such as higher learning qualifications, and incorporation of this requirement in each project to support overall on-the-job training. However, a sense that there is a lack of capacity remains

within RDM projects and in the broader water resource management environment. Skills and capacity shortages are regarded as one of the lead causes of the water crisis in South Africa (see Section 7.4.1). Skills development efforts do not seem to address the problem adequately, evidenced by continued outsourcing of technical tasks in the RDM activity system and process. The outsourcing *tension* surfaces through the continued reliance on external consulting teams, which in turn hinders active efforts for intentional internal capacity building. In addition, water resource practitioners on the ground, such as the provincial and CMA officials, experience a myriad of RDM implementation challenges ranging from the complexity of information, manifesting from a lack of handover processes to a further lack of capacity, in the form of *tools*, functional structures and human resources.

In terms of the second stage, implementation of RDM outputs, an observation is that the first gazetted RDM determination project outputs were published in 2016 for the Olifants Doorn, Olifants and Vaal catchments, conducted by various consulting teams. Nine years later, consulting team contracts have lapsed, and DWS staff members remain with the outputs and the task of implementing the Classes, Reserve, and RQOs in catchments within WMAs.

The RDM implementation challenge has been acknowledged by DWS, indicating that “while the policies and programmes for water resource protection have been endorsed and adopted, the difficulty remains in how to implement them in a cost effective and sustainable manner within a reasonable time. Therefore, much still needs to be done in the areas of implementation of water resource protection programmes and monitoring of ecosystem health to proactively minimise degradation of the resource” (DWS, 2013, p. 37). Evidently, RDM implementation challenges on catchment level have historically been reported, where provincial officials have not been able to translate RDM outputs into catchment management tools (see Sections 4.2.3.2 [b], 4.3.6 & 6.4.2.1 [a]). The contributing factors to the RDM implementation challenge range from lack of functional institutions at catchment level (see Section 7.31); misunderstanding and mis-interpretation of RDM outputs due to technical complexity; and similar capacity challenges as those experienced in the RDM determination phase encompassing resources (tools, financial and human resources) detailed in Section 7.3.2.

All the above have led to a challenge on the translation of RDM outputs into implementation *tools* or programmes and overall lack of implementation.

7.4.3.2 Social learning activity systems, contradictions and causal mechanisms

In the National Office RDM determination activity system, technical tasks in the determination of RDM are conducted by consultant teams while RDM project managers execute administrative functions related to projects, such as project coordination and management. This is evident in analysing the *division of labour* and *subject* nodes of the activity systems. In the *rules* node, implementation of RDM project outputs is delegated to provincial entities, intended to be supported by the national office. Similar to Section 7.4.1.3, in a complex activity, such as RDM undergoing capacity challenges, the organisation has resorted to outsourcing the function to consultant teams, and relying on their expertise and equipment. This necessitates negotiating capacity that is distributed across networks, as explained by Edwards (2011). In such circumstances, Edwards (ibid.) reminds us that some tasks are unpredictable and may require flexible responses, which could not have been anticipated.

The activity system factors, discussed in Section 7.4.1 on the capacity building challenge, pose a *tension* and challenge for implementation later in the process when consultants' contracts are completed and RDM project managers are expected to provide support and guidance to provincial officials on the technical outcomes, for translation into implementation tools, such as how they should feature into water use license conditions. Role-player AS3.2-RP2 was of the opinion that *implementing officials are essentially expected to implement RDM project tools for which internal RDM determination counterparts also might not know the full details or rational behind some of the details*. This presents *tensions* that manifest in National Office staff not being available to support provincial officials in implementation and answering queries. The fundamental contradiction lies in the *rule* that RDM outputs are to be implemented at catchment level. This presents as a contradiction, considering the inconsistent and varied participation of provincial officials throughout the RDM determination project and their unguaranteed presence later during implementation, due to staff turnover. It is highly likely, for an official, who was not part of the process, to be faced

with implementation tasks, due to migration and staff turnover. Considering that project execution was also outsourced, several layers of uncertainties are created (see Section 5.4.9 & 6.4.1.2 [a]). In addition, a transition process for handover of RDM outputs to implementing officials is absent. This creates a gap in the clarification of content and implementation guidance. This has led to misunderstandings and misinterpretations of RDM outputs, and associated challenges in the translation of RDM outputs into implementation tools and programmes.

Manifestations of contradictions in the current study were also found in the *tools*, in the form of *inconsistencies*. Various tools and approaches to the procedures for conducting RDM required through Regulations 810 (South Africa, DWA, 2010) have been applied by different consulting teams over the years. The need for standardisation was echoed by many role-players (see Section 5.4.1), citing that this would ease understandings of the outputs by stakeholders at the local implementation level. The underlying mechanisms for a lack of standardisation, however, stem back to the challenge of insufficient tools detailed in Section 7.3.2. In terms of causal mechanisms, the organisation has learned that tools get outdated with time. Models needed for the RDM process, mainly for data analysis and assessment, vary in versions. They mainly range in variable models for hydrology, water quality, geomorphology, and vegetation as examples. Given the complex nature of the RDM process, undertaken in a dynamic environment such as the South African water sector, not yet completed in all catchments, wanting in capacity, as outlined in Section 7.4.1, it is fair to agree with role-players that standardisation is not possible without the lead organisation providing the associated tools. Other role-players assert that the tools should not matter, provided that the outcomes of the process match its objectives (see Sections 5.4.1 & 5.4.6).

RDM determination and implementation activity systems are interlinked as discussed in Section 6.5.2. Hence, challenges cascade from one system to another and loop back, impacting on each other.

7.4.3.3 Findings and their significance for organisational learning

RDM determination has been undertaken for majority catchments in South Africa in response to the NWA (South Africa, 1998) Chapter 3 mandate. However, RDM implementation has been challenging. In this study, I found a range of RDM determination and implementation learnings experienced by role-players in the organisation at each level and some applicable to all levels, detailed next.

(a) RDM determination

Various operational changes have taken place in RDM determination attributed to organisational learnings by this study. How projects have been conducted in the past five years was found to be very different from 10 years ago. This bears evidence that learnings are being carried over with time and exemplified in this role-player quotation: *Integrated projects (Reserve, Classification and RQOs) have provided a platform for learning from each other. There is cross-pollination between RDM processes now and we are learning from each other and it has created a platform for communication. Also, project-wise enabling the use of compatible approaches within a project area and greater efficiency from one component of the work to the next (AS1.1-RP6).*

As outlined in the evidence of learning in Section 7.4.3.1, adaptive management is underway in the activity system, where the institution is effecting changes in response to implementation experiences. This is in line with Folke, Hahn, Olsson and Norberg (2005), who indicated that a key characteristic of adaptive management is iterative learning that enables humans and institutions to cope with uncertainty and change; and with the concept of social learning according to Keen et al. (2005). However, Mudau-Mushwana (2020) found that the revision of process elements to avoid challenges encountered in the past resonates with single loop learning, but not learning of the deeper double and triple loop kind as defined in Section 2.4.2.

As noted in Section 7.4.3.2, standardisation was introduced for the format of RDM outputs through gazette templates, responding to the call for standardisation of relevant aspects of the RDM process, including the tools used and the process (see also Section 5.4.1). I found

that, the actual value of standardisation is in the careful documentation of decisions, rationales and steps taken for ensuring future understanding, improvement, and replicability of the process, and most importantly, learning from and through these processes. However, standardisation would not be possible in the instances of tools in the form of models and programs, which do not stagnate but over time are updated. So that these tools, in essence, keep changing. In such instances, where required tools have changed and thus unavailable, according to Glasser (2007), Wals et al. (2009) and Edwards (2011), boundary crossing or horizontal learning should be considered, characterised by situations where practitioners must move across boundaries to seek and give help, drawing on horizontal expertise, to find information and tools wherever they happen to be available.

The critical realist orientation of this study (see Section 2.4.5) allows retroductive analysis of the RDM activity within the macro-economic context of DWS (see Section 3.5.4). Contrary to opinions of the majority of role-players regarding standardisation of the RDM process, the opposite appears to be what is needed. The RDM water resource protection practice is fairly new with the oldest RDM determined projects that are gazetted, only being nine years old. The conditions under which to fulfil a complex and ambitious mandate are still changing, fast-moving and dynamic. Given the high dependence on outsourcing processes, and the dynamic system, RDM processes cannot be standardised.

(b) RDM implementation

Role-players reported that there is as yet no platform or process for hand-over of completed RDM for implementation. Outputs are published in government gazettes, technical reports and on a website without a dedicated transition process for implementation. Engagement with implementers is through the overall project stakeholder engagement process, which role-players have expressed is not enough, due to various factors ranging from staff turnover to lack of understanding and clarity on how implementation ought to be executed. As an example, AS1.1-RP3 indicated that implementation of RDM outputs is hindered by *complexities of the process in determining how the outputs translate into license conditions*.

In addition, a role-player in KZN indicated that: *What is needed is clarification of roles and responsibilities; and articulation of implementation actions and clear demarcation of roles and responsibilities* (AS2.1-RP3). Furthermore, a role-player in Mpumalanga indicated the importance of *identification of implementing role-players who need to take the work forward on the ground; and elaborated that once identified, they need to be provided with a full suite of the RDM outcomes and guided on how these should be implemented* (AS3.1-RP3).

Workshop role-players in KZN indicated the need for knowledge sharing and awareness creation amongst role-players and the integration of efforts within and across institutions, including SANBI, uMngeni Water, Ethekweni Municipality, amongst others, who are all undertaking work that contributes to the implementation of RDM. A key finding was the need for the DWS provincial office to not only collaborate, but to co-ordinate efforts on the ground, and to address gaps.

This study found that a major gap exists in the transition from RDM determination to RDM implementation at catchment level driven by various institutional and operational challenges, with significant learning implications for the organisation.

(c) RDM determination and implementation

In both RDM determination and implementation internally, within the organisation, role-players attested to the need for engagement among different units, and associated learning, due to interlinkages between them as depicted in Figures 6.8 and 6.9. This is demonstrated in the following extended quotation which also points to the need for coordination of such interactions and learning: *Learning that we need to work as Teams and cooperation is needed between the different Directorates as our work is interlinked. As an example data collected by RQIS is critical for feeding into RDM projects; similarly as Reconciliations projects conducted in Water Resource Planning are critical in RDM projects. Internally, all units are interlinked – a central hub is needed to ensure full understanding of how each fits into the puzzle. An example is the importance of water ecosystems management in the ultimate water service provision, if water resources are not protected/conserved, there will be no water for water services provision* (AS1.1-RP8).

Among the key findings of the study was the importance of defining clear roles and responsibilities for each unit involved and similarly, clearly defining roles and responsibilities for staff members. In addition, resources (tools, financial and human resources) were found to be a critical pre-requisite for execution of tasks across the board, at both the determination and implementation level, as detailed in Section 7.3.2.

Lastly, on the policy level currently, another change responding to experiences of practitioners on the ground is the DWS National Water Amendment Bill (South Africa, 2023) and the Water Service Amendment Bill (South Africa, 2023b), which aim to make changes to the water legislation based on challenges experienced over the past 28 years of implementing the NWA (South Africa, 1998) and Water Services Act 108 of 1997 (South Africa, 1997). This is a big step in terms of organisational learning, where steps are being taken to address gaps and short-comings experienced in practice. A factor found in the current study that is being addressed in the National Water Amendment Bill (South Africa, 2023) is the provision for the review of RDM outputs with a specified timeframe of “no less than 10 years”. The need for this provision to review gazetted RDM outputs is a call that was found across all the IRRs in document analysis (see Section 4.2.1.2).

Learning comes full circle when it is embedded in the organisation (Wenger-Trayner, Wenger-Trayner, Cameron, Eryigit-Madzwamuse & Hart, 2017). The findings summarised and discussed here suggest that there are a number of learning growth buds in the organisation, some bigger and some smaller. Many are informed by role-player experiences as they conduct subsequent projects. Learning is observed in policy reviews, changes in project approaches, for example, increased integration, and attention to data management initiatives. To bring such learning full circle into shaping a learning organisation, needs deliberate platforms and mechanisms for enhancing and harnessing social learning.

7.4.3.4 Recommendations

To enable adaptive management, monitoring, reporting and evaluation on RDM determination and implementation processes is necessary to track developments. Comparisons must thus be made between recent and older projects to purposefully draw lessons and trace shortcomings and best practices for informing future projects, on a single loop (Mitchell, 2013) learning level. However, to enable decision-making where deeper or more far-reaching changes need to be made to strengthen itself as a learning organisation. This study found that the learning associated with RDM ought to expand into double (Argyris and Schön, 1978, Mitchell, 2013) and triple loop (Georges, Romme & Witteloostuijn, 1999; Mudau-Mushwana, 2020) social learning processes focusing on strategic, proactive, generative and frame-breaking organisational behaviour and collective meaning making. I recommend that, organisationally, a purposeful and deliberate effort must be made to facilitate learning.

Compilation of implementation actions, communicating and clarifying them and sharing of experiences is critical for supporting implementation processes and actions. This was the view of role-players in the Mpumalanga provincial implementers activity system (see Section 5.4.3). Drawing on stakeholder inputs and the literature on boundary crossing and distributed competence, I recommend that implementation be conducted between the national and the provincial officials, together and in cooperation with other external stakeholders, boundary crossing to fill capacity gaps. This could enhance accuracy in interpretation of RDM outputs. Similarly, determination should be conducted, together, between national office and provincial and local CMA implementers, the '*witness*' suggested by role-players. An official transition process, from determination to implementation, is critically needed. One of its first requirements would be for the final technical reports supporting the information in the gazette, to be readily available and extensively communicated to implementing units. This should include identifying the personnel responsible for the implementation of the project outputs and providing them with a full suite of technical information. Secondly, the development of action plans articulating responsibilities by defining what needs to be done and by whom, must be prioritised.

Furthermore, integration is needed both internally between DWS units, and between DWS and other institutions with a shared mandate. Principles for working together such as cooperative governance, integrated water resource management and sustainability ideals, need to be supported in a tangible manner and penned into strategies, guidelines and policy documents, to support practicalities of working together across units internally, and externally in the sector.

In light of all of the findings in Section 7.4.3.3 above, the complex, interlinked nature of the case study activity systems, and distributed capacity, there is a critical need for co-learning in the activity systems. The RDM activity system therefore needs to focus on a specific kind of learning for 'collective meaning making', social and expansive learning.

7.5 CONCLUSION

This chapter presented a consolidation of findings from Phase 1 and 2, analysed further through a critical realism lens. The identified study activity system factors manifesting as Chapter 6 emerging contradictions, mainly *conflicts*, *critical conflicts*, *dilemmas* and *double binds* (Engeström & Sannino, 2011), *tensions*, *inconsistencies*, *conflicts of motive* and *disturbances* (Jalasi, 2018) were probed further through retroductive reasoning (see Section 3.5.4) to deepen insights and identify causal factors and recommendations. Among the key recommendations is the adaptation of RDM processes for water resource protection in South African water ecosystems management, to recognising it as a complex social-ecological system supported by a type of learning where multiple processes interact at different scales of action. These adapted processes would include establishing the roles of leaders and networks, managing interlinked systems of knowledge, collective sense-making of information, and building trust and social capital in the system. It would also need to determine the extent to which boundary and bridging organisations are able to collaborate and share their particular experiences, to stimulate collective action and build capacity to adapt to change. This would require a reflexive institution, adaptive with mechanisms to incorporate lessons from disturbances of social-ecological systems, and the design of institutional structures capable of functioning over a range of domains and scales of action.

Learning for effective and efficient RDM processes in the context of sustainable water resource management draws on five intertwined strands of social learning. These include reflection, social-ecological systems orientation, integration, negotiation and participation (outlined in Section 2.4.1). In this context, social learning approaches are proposed and recommended to better engage, and work with role-players, internally and externally, cognisant of cultural, social, ecological and economic factors required to secure water resource protection, and ensure *some, for all, forever*.

8. CHAPTER EIGHT: CONCLUSION AND REFLECTION

8.1 INTRODUCTION

In this study, I explored organisational learning amongst role-players working with Resource Directed Measures (RDM) determination and implementation in water ecosystems management for water resource protection in South Africa. I set out to address the research aim (detailed in Section 1.4) *to explore what new perspectives and learnings from RDM initiatives a social learning lens can unearth towards more sustainable water ecosystems management in South Africa*. To address this aim, I developed research objectives and followed a phased approach. In Phase 1, the research Objective 1 was *to identify enablers and challenges relating to policy, institutional and operational factors in the context of RDM*. Through a social learning lens, I focussed on surfacing policy (legislative), institutional and operational causal factors that either enable or constrain RDM within broader contexts of water resource management. In Phase 2, the research Objective 2 was *to examine the implementation experiences of role-players and identify their associated learnings derived from participation in identified RDM interventions*. In Phase 3, the research Objective 3 was to draw lessons about and make recommendations for organisational learning in the context of RDM policy implementation. Identifying water ecosystems management, through RDM, as a phenomenon of interest, I hoped to surface possibilities for new learnings by identifying and more deeply exploring causal factors in long-standing water resource management challenges in the water sector. The section below provides a conclusion to this research journey.

8.2 CONCLUSION

Phase 1, involving document analysis, was valuable not only for providing the contextual background of the study, but for identifying key factors in RDM determination and implementation, detailed in Chapter 4. The analysis of these factors culminated in the identification of key enablers and challenges in the overall case study context, being RDM determination in the National Office of the Department of Water and Sanitation (DWS). Documents such as the Issues and Response Registers (IRRs) were instrumental in this early phase of the study for providing access to stakeholder and role-player voices. This phase of

the study provided me with contextual information as well as existing organisational learnings, that I was able to take into semi-structured interviews and wider sector engagements, as mirror data for role-player reflections, feedback and further insights.

Phase 2 was characterised by a vibrant series of semi-structured interviews covering all three case study contexts, as detailed in Chapter 5. Phase 1 study findings were shared with role-players to introduce the study and to stimulate discussions. Based on this, RDM role-players provided feedback, shared their lived experiences and offered recommendations, which added immensely to the depth of the study. Role-players generously and openly shared insights derived from their experiences of working in the national and two provincial activity systems. The research progressed by capturing data regarding ongoing or past events, always asking, why they happened or are happening, in a continuous reflection process on the data. The data was then analysed using a Cultural Historical Activity Theory (CHAT) framing and contradiction analysis, described in Chapter 6. Interpreted through a social learning lens, underlaboured by critical realism, the study identified causal mechanisms that can be regarded as having contributed to observed events, discussed in Chapter 7.

Manifestations of contradictions surfacing in the national state organisation case, DWS, were found to play a major role in shaping RDM determination and implementation throughout the system, from national office process, through to provincial and Catchment Management Agency (CMA) implementation of water management actions inclusive of RDM. These manifestations of contradictions, discussed in Chapter 6, were retroductively analysed to identify their underlying causal factors outlined as emerging themes in Chapter 7. Although many of these key themes emerging through the study are not new, the primarily exploratory nature of this qualitative research, with its critical realist orientation, offers a deeper understanding of known issues in the field by probing the underlying reasons, root causes and motivations behind them.

In the policy and legislative macro-environment, South Africa is deemed to have some of the most progressive water policies and strategies, that serve as *tools* for transformation, being strongly based on social and environmental justice. This suite of policies stem from the

Constitution of the Republic of South Africa (see Section 4.2.1.1), that provides a firm base for progressive environmental legislation and calls for the right to a safe environment for all. In combination, the Water Services Act 108 of 1997 and the National Water Act 36 of 1998 (hereafter the NWA) were designed to redress past racial inequalities and discrimination (see Section 4.2.1.1). Among the key enablers identified in the national policy framework, is Chapter 3 of the NWA (see Section 4.2.1.1) that commits the country to comprehensive water resources protection and provides for a series of RDM measures (detailed in Section 2.3.1.4) towards this aim. The study found that there has been a considerable amount of resourcing efforts to enable sustainable water ecosystem management in South Africa, through RDM. In response to the legislative prescriptions of the NWA, various RDM projects have been undertaken by DWS, throughout the country, to give effect to its water resource protection mandate through the determination of Water Resource Classes, the Reserve and Resource Quality Objectives.

However, implementation of the available legislative instruments, including RDM outputs, has proven challenging over the years. My study found that the challenges, at least in part, stem from the fundamental dual nature of the transformational *object* of water resource protection through RDM in South Africa. It seeks to contribute towards some water for all in the country, through water resource protection for environmental conservation while balancing socio-economic development through use; within a context where institutional legacies in water resource management are not yet fully transformed. Slow institutional reform is evident, for example, in the prolonged processes for establishing Catchment Management Agencies (CMAs), and the ambivalent commitment to decentralisation (see Section 7.3.1). Implementation actions at local provincial and catchment levels are dependent on functional CMAs but also measures to enable ongoing learning and adaptation. This study shows clearly that the delegation of RDM implementation to a local level, needs not only functional institutions, but built-in processes or platforms for learning to support the associated functions.

Other factors hindering successful RDM implementation, previously identified and documented by DWS, range from droughts driven by climatic variation, deteriorating water

quality and insufficient water quantities, to lack of skilled human resources for water resource management (see Section 1.2.2). This study confirmed that water authorities' institutional resource constraints include human, tools and financial capacity challenges, which in turn hinder operational capacity.

An interesting finding was that some policy provisions were both an enabler, and a constraint. An example is the lack of provision for review of gazetted RDM outputs, which is enabling for ensuring water resource protection where stringent protection measures cannot be altered, but challenging when errors cannot be corrected, gaps cannot be filled, and grey areas cannot be clarified. At the time of writing this thesis, the DWS NWA Amendment Bill was underway, incorporating a provision for the review of RDM outputs within specified time frames. This example of efforts for addressing gaps identified in the legislation bears evidence that learnings have occurred in the organisation over the years.

In the institutional category, the DWS Water Ecosystems Chief Directorate is dedicated to RDM determination. This organisational structure, dedicated to water ecosystems management was found to be enabling for the execution of RDM determination function, in its entirety. Integration efforts undertaken by this unit over the years evidence learning, based on the prior challenges resulting from separated RDM components. The institutional arrangement for implementing RDM outputs at the catchment level is the function of local water resource management institutions, provincial offices and ideally CMAs, in accordance with the envisaged decentralised water resource management system (see Section 7.3.1). Determination takes place at the National Office. However, the establishment of functional, local implementation CMA institutions was among the key challenges found. Where a fully-fledged CMA is not yet in place, such as in the KwaZulu-Natal case, provincial offices function as both proto-CMAs and provincial offices. This was found to compromise implementation of RDM outputs at a local level due to unclear roles and responsibilities, compounded by capacity constraints in DWS provincial offices. The lack of functional institutional structures was therefore dominating the factors found to inhibit effective implementation of RDM outputs. Although DWS was in the process of establishing CMAs at the time of writing this

thesis, a role-player noted that it will take time for the newly formed institutions to be fully functional.

In the operational category, the legislative and institutional challenges or shortcomings surfaced as well. For example, in the RDM determination case (see Sections 6.3.1.1 & 6.4.1), where gazetted outputs sometimes have errors, they present confusion and misinterpretation when being incorporated into local catchment management tools. This stems from the legislative shortcomings of the lack of a review provision, mentioned earlier, and the lack of a platform for making corrections (see Section 5.4.2).

Other challenges emerging as key themes were capacity and stakeholder engagement, both of which cascade down and impact on the implementation of RDM outputs. In terms of capacity, findings were unequivocal, in recognising fully equipped institutional structures, ranging from the requisite qualified and experienced human technical expertise and the financial and institutional tools for the execution of RDM tasks, as critical. Building the requisite system capacity requires investment in a variety of suitably qualified and technically skilled personnel, budgetary provisions and institutional mechanisms and tools, such as technological models, working equipment and functional units, critical for the execution of RDM functions and sustainable service delivery. This study found capacity building to be a long-term process, requiring sustained learning-by-doing to improve technical capabilities related to the RDM functions. Through the social learning lens used in this study, such learning-by-doing should be achieved by optimally using internal and external expertise: differentiating between core operational activities that should be retained and conducted in-house and outsourcing; identifying where in-house expertise exists and can be applied, and hiring consultants only where there are capacity gaps. This would encourage hands-on capacity building within the organisation, where executing tangible tasks would be unlocking practical learning opportunities and addressing identified skills gaps. A platform for co-learning and information sharing could enhance the ability of practitioners to reflect and learn from their own and others' experiences during and post every RDM project. This would encourage them to explore options and co-generate solutions to challenges. Such interactions need to be harnessed through specifically designed social learning platforms.

The NWA shifted the *object* from water provision for an exclusive few, to providing *some, for all, forever* (see Section 7.2.1), an *object* that is both transformational and complex in nature. My study found that conceptualisations of what water resource management capacity is, where it should reside and how it can be developed and deployed, do not match this new *object*. Amongst some role-players, the main understanding of capacity still seems to be that we simply need high level technical skills in isolated units who will provide the technical guidelines for others to implement. Yet, to achieve *some, for all, forever*, a range of social and technical skills are needed, distributed throughout the system, extending beyond a single unit or even organisation, and well convened, as and when needed. *Some, for all, forever* is a challenging mandate, not achieved before, and it stands to reason that different role-players will need to learn as they fulfil their roles towards achieving this vision, in relation to each other. Learning to work together and optimise distributed capacity, is needed, but this seems to be a key gap in the efforts of the past 10 years.

Stakeholder engagement is a core component of RDM processes, legislatively prescribed as part of integrated water resource management and decentralisation participatory efforts (see Section 7.4.2). Extensive stakeholder engagement is critical during and on completion of RDM projects. This ensures that important information about water management measures reaches all relevant stakeholders, and facilitates the requisite participation in knowledge production, standard setting and implementation. My study found that stakeholder engagement plays a number of important roles, and that these purposes need to be clearly defined to allow for differentiated stakeholder engagement in RDM processes, across different groups of interested and affected parties, for reaching and accessing information sources inclusive of indigenous knowledge. Knowledge sharing and harvesting requires learning tools that foster feedback and encourage dialogue. This study further identified the need for continued engagement with all catchment level stakeholders through local platforms. Facilitation of such platforms would be key for ensuring deliberate training to enable stakeholders to participate meaningfully and ensuring inclusive, equitable facilitation methods.

The misalignment between RDM determination and transitions to implementation emerged as a key area of challenge. Role-players responsible for catchment management at provincial and CMAs offices lack clarity and direction on what constitutes the implementation of RDM outputs, and how they need to proceed in implementation actions. The study demonstrated a need for a dedicated process for communicating and clarifying implementation actions to identified implementation officials.

Operationally, standardisation of output formats and documenting of approaches and processes, as well as changes in these, were found to be key for running sound, replicable processes and avoiding confusion for stakeholders and implementation officials when interpreting RDM outputs. Organisational learning was evident in the integration of Classification, Reserve and RQOs determination, now being conducted simultaneously in RDM processes. This was found to be effective in bridging data gaps, promoting co-generation of outputs and learning in the system, and to enable process efficiencies. Adaptive management and single loop learning efforts were evident, examples being refinements of terminologies, standardising outputs templates and inclusion of dams in projects. Drawing on the work of Mitchell (2013), Mudau-Mushwana (2020) and others, this study found that to strengthen itself as a learning organisation, the learning associated with RDM ought to expand into double (Argyris and Schön, 1978) and triple loop (Georges, Romme & Witteloostuijn, 1999) social learning processes focusing on strategic, proactive, generative and frame-breaking organisational behaviour and collective meaning making.

Overall, there are many interlinkages in the system, some of which are demonstrated in Figures 6.8 and 6.9. Factors cascade from the legislative to the institutional and ultimately the operational level, and loop back, impacting on each other. These interlinkages are also evident in the water ecosystems management mandate being shared, legislatively and institutionally, with other institutions. This therefore necessitates deliberate integration and cooperation, critical for capitalising on outcomes of other initiatives. It facilitates reaping the benefits of economies of scale and maximising resources, by avoiding duplication of efforts.

Given the systemic nature of organisational challenges such as capacity, participation and implementation, the study therefore concludes that:

- in a complex activity such as RDM, it is acknowledged that capacity is distributed across networks and needs to be negotiated with others for joint action;
- learning from each other for collective meaning-making and sense-making is critical;
- while recognising that some tasks are unpredictable and may involve flexible responses that could not have been anticipated.

To shift out of the points of *tensions*, into more intentional learning processes and applying learning in multi-voiced RDM activity systems, reflexivity and collaboration across boundaries and among role-players that share objects in activity systems, are key. Capacity building and stakeholder engagement are pivotal processes in the system, embedded within the wider water ecosystem management activity system. The kind of active social learning needed, co-learning among role-players, needs organisational commitment to unlock the expansive possibilities that exist.

8.3 RESEARCHER REFLECTIONS

I believe that approaching the research as an insider researcher went a long way in gaining access to, building trust with and obtaining rich, honest and passionate data from role-players, because of the rapport I was able to build. I had considerable access to data, and I felt that role-players did not hold back, considering how they opened up about the issues and challenges experienced and what they had learned through these. Being an insider also came with the responsibility of handling data with sensitivity and the necessary ethical considerations, as entrusted to me by the participants in the research.

Many role-players expressed excitement to participate in a study of this nature, as an opportunity to reflect on and share their lived experiences in RDM projects. As a result, surfacing the voices of these water practitioners is one of the special offerings of this study, as we seldom get to hear the direct views of role-players involved in efforts to realise challenging mandates under equally challenging circumstances.

The challenge with being an insider researcher and the multiple vantage points I have had, shaped through my career journey (see Section 1.6), has been to work with the data, from documents and role-player voices, and present it authentically, and not through my opinions. This challenge led to extensive reflections on all data points, role-player checks and clarifications and several processes of verifying data sources. These vantage points have, however, also been beneficial to the study to make informed decisions on selection of activity systems. An example is the origin of my career in water resource monitoring programmes, I used this knowledge and vantage point to make an informed decision to focus on the data theme only as far as points that apply to the broader case study due to my knowledge of the vast nature of this theme which was beyond the study scope. Furthermore, as an insider researcher I had to be aware of possible bias and take steps to eliminate errors it may bring to the research, while knowing that it might also bring unique insight (see Section 1.7). CHAT provided a structured research theory that allowed critical analysis of the research context, alongside deductive, inductive and retroductive modes of inferences in critical realism.

I chose CHAT, underlaboured by critical realism (see Section 2.4.5), as my theoretical, conceptual and analytical frameworks. Because the chosen case study area (DWS) is a state organisation with a hierarchical operational structure, I chose to work with (second generation) CHAT only to gain an understanding of the activity systems, their nodes and to provide a contextual mapping of the contradictions at play and set the scene for future possible expansive interventions. An expansive learning process was deemed unfeasible, although a key study recommendation for future work, given the complex social-ecological nature of water resources and the multi-organisational nature of the role-players involved.

As an insider, the operational mandate of DWS to manage water resources is our commitment as staff members. Upon working with social learning theory, it quickly became evident to me that water resource management is largely approached through natural sciences and engineering approaches leaving a gap for drawing from a range of other disciplines, knowledge sources and research approaches. Understanding of learning processes, associated learning theories, co-creation in capacity building and inclusive stakeholder

engagement processes were important prerequisites for institutionalising social learning as a complementary governance framework for water resource management.

Presentation of chosen study areas through activity systems provided a visual tool that was useful for representation of the interacting components or nodes, such as *tools*, *rules*, *community*, *division of labour* and *subjects* or role-players. In addition, it provided the framework for the contradiction analysis used. Activity systems provided accessible language and visual presentation for interaction with role-players, to obtaining inputs, insights and feedback. The cultural historical aspect of CHAT also aided the probing of these aspects that emerged from document analysis and role-player engagements, and suggested underlying causal mechanisms. Role-players provided insights that enhanced the picture of the activity systems substantially, and through these interactions, activity systems were updated with role-player inputs (see Figures 6.3, 6.4, 6.5 & 6.6). Retroductive analysis of emerging contradictions, deepened by study findings, provided a means for accessing underlying factors, or causal mechanisms that were otherwise not visible in the empirical data. Each activity system was found to be complex, with multiple role-players and possible interactions with other activity systems, internally in DWS and sector-wide (see Section 6.5.2), that share the same *object*, a clear sign of expansive possibilities. Exploration of the shared *object* in the RDM activity systems, through expansive learning, holds much promise for resolving the *tensions* and contradictions identified in the study. I, therefore, recommend future transformative, interventionist research to convene platforms for facilitated dialogue amongst role-players in the activity systems, as a platform for learning. Such transformative social learning should encourage engagement, foster and harvest learnings and reflexive engagement amongst role-players.

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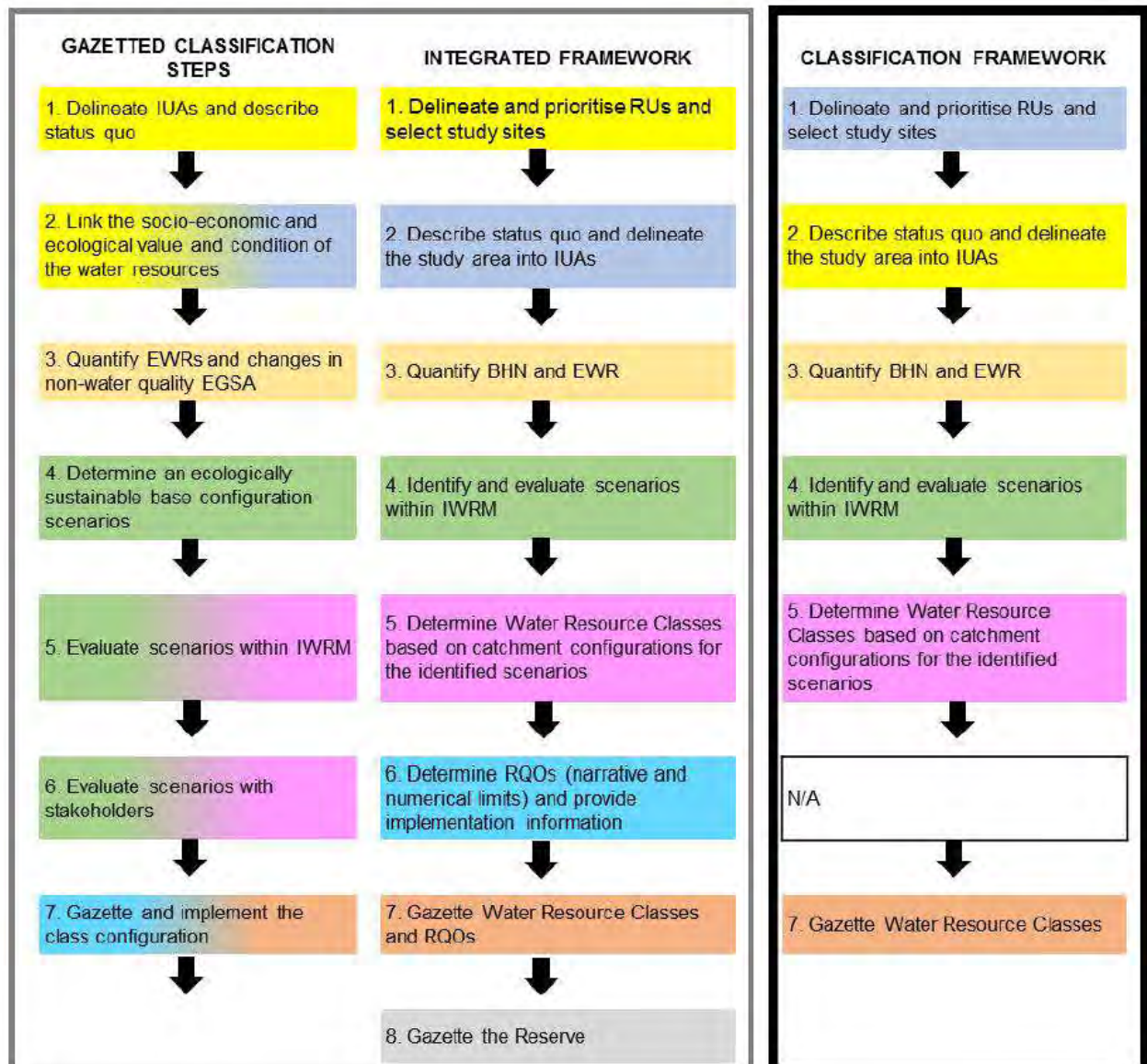
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APPENDIX 1: RDM INTEGRATED STEPS FRAMEWORK

Source: South Africa. DWS (2017b)



APPENDIX 2: HISTORY OF RDM PROJECTS IN WATER MANAGEMENT AREAS

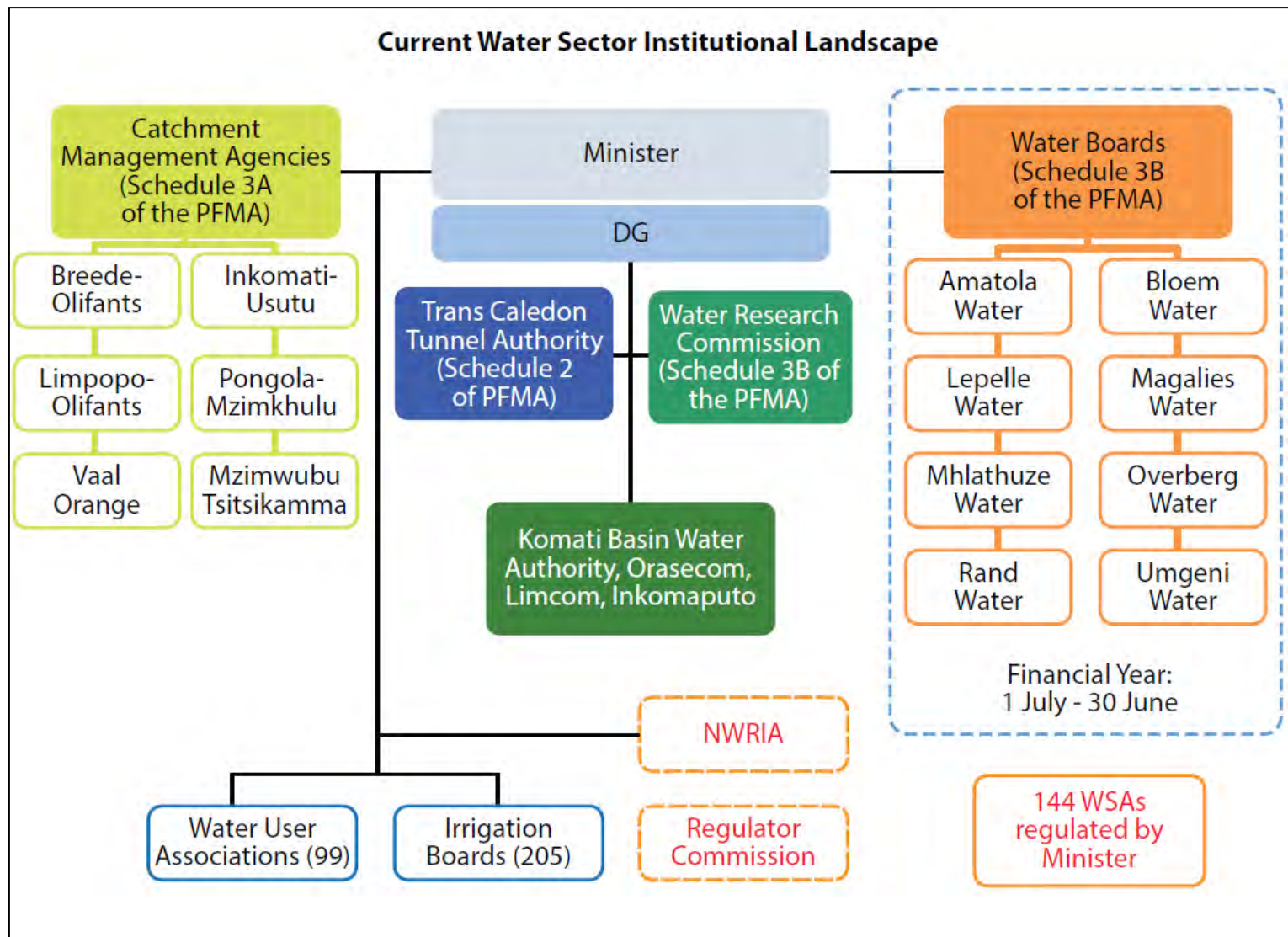
Source: South Africa. DWS (2024)

Water Management Areas or Catchments	RDM Components Completed	Gazette Number and Year	Professional Service Provider Team Appointed
Olifants/Doorn	Water Resource Classes and RQOs	39943 of April 2016	BlueScience Consulting cc
	Reserve	41473 of March 2018	
Olifants	Water Resource Classes and RQOs	39943 of April 2016	Golder Associates Africa, Zitholele Consulting, Prime Africa and Retha Stassen
	Reserve	41887 of September 2018	
Vaal (Upper, Middle, Lower)	Water Resource Classes and RQOs	39943 of April 2016	WRP Consulting Engineers (Pty) Ltd with DMM Development Consultants CC, Rivers for Africa eFlows Consulting (Pty) Ltd, Conningarth Economists, Koekemoer Aquatic Services and Zitholele Consulting (Pty) Ltd.
	Reserve	43734 of September 2020	
Letaba	Water Resource Classes and RQOs	40531 of December 2016	Pulles Howard and de Lange Inc.
	Reserve	41887 of September 2018	
Inkomati	Water Resource Classes and RQOs	40531 of December 2016	Huggins G, Louw MD, Mallory S, Van Jaarsveld P and Van Rooyen P.
	Reserve	42584 of July 2019	
Mvoti to Umzimkulu	Reserve, Water Resource Classes and RQOs	41306 of December 2017	Rivers for Africa eFlows Consulting (Pty) Ltd
	Reserve	41970 of October 2018	
Crocodile (West) Marico, Mokolo and Matlabas	Water Resource Classes and RQOs	42775 of October 2019	Golder Associates Africa, RMM Stassen, Prime Africa, Wetland Consulting Services, Zitholele Consulting
Crocodile (West) and Marico	Reserve	45568 of December 2021	
Mokolo and Matlabas	Reserve	45735 of January 2022	
Mzimvubu	Water Resource Classes and RQOs	43015 of February 2020	Scherman Colloty and Associates cc
Breede-Gouritz	Water Resource Classes and RQOs	43726 of September 2020	Aurecon South Africa (Pty) Ltd in sub-consultancy association with

Water Management Areas or Catchments	RDM Components Completed	Gazette Number and Year	Professional Service Provider Team Appointed
			Southern Waters Ecological Research and Consulting, Anchor Environmental and Delta-H Water Systems Modelling
	Reserve in progress	44945 for 60-day period comment	
Berg	Water Resource Classes and RQOs	43872 of 06 November 2020	Aurecon South Africa (Pty) Ltd, Southern Waters Ecological Research and Consulting, Anchor Environmental and Delta-H Water Systems Modelling
Thukela	Water Resource Classes and RQOs	48187 of 10 March 2023	Golder Associates Africa in association with AECOM, Prime Africa, Wetland Consulting Services, JMM Stassen, Zitholele Consulting, Dr Gavin Snow and Andre Joubert Communication Services
Usutu to Mhlathuze	Classes and RQOs Reserve study undertaken (2014)	In progress - commenced in December 2021 and scheduled to be completed in August 2024	WRP Consulting Engineers (Pty) Ltd
Luvuvhu	Water Resource Classes, Reserve and RQOs	In progress – commenced in October 2021 and scheduled to be completed in September 2025	Myra Consulting (Pty) Ltd with Southern Waters, Anchor Research and Monitoring and Delta-H as SubConsultants
Keiskamma and Fish to Tsitsikamma	Water Resource Classes, Reserve and RQOs	In progress – commenced in September 2021 and scheduled to be completed in March 2025	GroundTruth: Water, Wetlands and Environmental Engineering
Orange (Upper and Lower)	Classes and RQOs	In progress – commenced in 2024	WSP Africa Group (Pty) Ltd

APPENDIX 3: SOUTH AFRICAN WATER SECTOR INSTITUTIONAL LANDSCAPE

Source: South Africa. DWS (2023)



APPENDIX 4: ROLES AND RESPONSIBILITIES OF WATER RESOURCE MANAGEMENT INSTITUTIONS

Source: South Africa. DWA (2013) and DWS (2018); NBI (2019)

Organisation	Roles and Responsibilities
Department of Water and Sanitation (DWS)	- Responsible for water and sanitation policy, regulation of water supply and sanitation provision, oversight of water sector institutions, water resources planning, operation and maintenance of 320 large dams and associated bulk infrastructure, regulation of water use and the collection and assessment of water data. - DWS oversees the 144 Water Services Authorities (WSAs) that are responsible for water services provision to communities.
Catchment Management Agencies (CMAs)	Catchment Management Agencies are responsible for water resource management in Water Management Areas. Where CMAs are not yet established, DWS regional offices fulfil the functions. To date, only 2 of the 9 envisaged CMAs have been established in terms of the National Water Act.
Water User Associations (WUAs) and Irrigation Boards	Approximately 90 WUAs and 177 irrigation boards exist to manage common water resources, in some cases including infrastructure for irrigation and some of these for government water schemes.
The Water Research Commission (WRC)	The WRC commissions research into water and sanitation issues, funded by a levy paid by water users. The WRC thus exists to drive research, development and innovation strategy, fund research activities and organisations and synergise with partners to shift solutions to practice.
The Council for Scientific and Industrial Research (CSIR)	The CSIR is a leading scientific and technology research organisation that researches, develops, localises and diffuses technologies to accelerate socioeconomic prosperity in South Africa.
Water Boards	- Established in terms of the Water Services Act 108 of 1997, have a primary function of providing water services to other water services institutions and with secondary functions which could include supporting municipalities. - Responsible for bulk water and sanitation infrastructure provision to municipalities within their respective service areas.
South African Local Government Association (SALGA)	SALGA is an association of municipalities that serves as the representative voice of all 257 municipalities in South Africa with the mandate to represent, promote and protect the interests of local governments and to raise the profile of local government.
Municipalities	144 municipalities in South Africa are designated as WSAs, responsible for the constitutionally mandated task of supplying potable water and sanitation services, either as water service providers (WSPs) themselves, or externally through third party WSPs.
Department of Cooperative Governance and	COGTA is responsible for ensuring that all municipalities perform their basic responsibilities and functions consistently, including supporting the delivery of municipal services to the right quality and standard; promoting good

Organisation	Roles and Responsibilities
Traditional Affairs (COGTA)	governance, transparency and accountability; and ensuring sound financial management and accounting. However, in relation to water supply and sanitation, DWS is the accountable national department.
Municipal Infrastructure Support Agent (MISA)	• MISA is mandated to provide technical capacity support and to assist municipalities to build their internal capacity, with the goal to improve service delivery and infrastructure management.
Department of Forestry, Fisheries and Environment (DFFE)	• Responsible for environmental management, conservation and protection towards sustainability for the benefit of South Africans and the global community. • Mandated to give effect to the right of citizens to an environment that is not harmful to their health or well-being, and to have the environment protected for the benefit of present and future generations.
The South African National Biodiversity Institute (SANBI)	• SANBI contributes to South Africa's sustainable development by facilitating access to biodiversity data, generating information and knowledge, building capacity, providing policy advice, showcasing and conserving biodiversity in its national botanical and zoological gardens.
National Treasury	• Disburses grants for water and sanitation and provides oversight of municipal finances.
Government Technical Advisory Centre (GTAC)	• As an agency of National Treasury, GTAC provides advisory services, programme management and development finance support to improve public finance management, as well as to strengthen infrastructure planning and delivery.
Development Bank of Southern Africa (DBSA)	• The DBSA supports the development of water and sanitation infrastructure by providing financing to municipalities and regional water boards.
Trans Caledon Tunnel Authority (TCTA)	• The Trans Caledon Tunnel Authority (TCTA) was initially established to fund the Lesotho Highlands Water Project (LHWP), but subsequently directed by the Minister to fund and implement a variety of water resource projects as an implementing agent for DWS.

APPENDIX 5: PARTICIPANT INVITATION, INTERVIEW QUESTIONS, CONSENT FORM AND ETHICS CLEARANCE LETTER



RHODES UNIVERSITY
Where leaders listen

ENVIRONMENTAL LEARNING RESEARCH CENTRE

Rhodes University
PO Box 94, Makhanda, South Africa, 6140
Research Office

• Tel: +27 (0) 46 603 7727 • E-mail: ethics-coordinator@ru.ac.za

March 2023

Attention: Sir/Madam

RE: REQUEST FOR YOUR PARTICIPATION IN A STUDY TITLED EVALUATING LEARNING IN WATER ECOSYSTEMS MANAGEMENT IN SOUTH AFRICA: TWO CASE ANALYSES OF SOCIAL LEARNING AMONG ROLE PLAYERS IN RESOURCE DIRECTED MEASURES

My name is Mmaphefo Thwala, a PhD scholar at Rhodes University. I'm currently undertaking research in a study titled **as above**. As a valued practitioner in the South African Water Sector, you are invited to participate in this study as a key informant in semi-structured dialogue interviews.

Study Motivation

The study is motivated by the realization that healthy freshwater ecosystems have the potential to make a significant contribution towards improved water quality and ultimately water availability, and benefits across the water value chain as natural support systems. Various initiatives have been commissioned in South Africa for ensuring functional water ecosystems, sustainable development of water resources and water security through Resource Directed Measures (RDM). However, factors relating to policy, governance/institutional arrangements, partnerships, and skills have presented various challenges for the implementation of RDM interventions. Thus, a significant number of water resources are currently degraded and in poor condition.

Study Purpose and Selection of Participants

This study seeks to apply a social learning lens to explore experiences of key role players in RDM initiatives in terms of policy, institutional and operational factors that impede sustainable water ecosystem management in South Africa. This is in an effort to unearth key learnings for possible future implementation solutions. The intended participants are water ecosystems management practitioners (national, regional, sector partners) based on their expertise in water resource protection.

Process

If you decide to take part in the study, please complete the attached consent form. In the study itself you will be asked about your experience in water ecosystems management, with the aim of understanding the learnings that you have acquired over the years in your role in water resource management. Please see **Annexure A** below with examples of the questions that will be explored during the interview. The semi-structured interview will be conducted at a professional venue and time of your convenience. The interview will be audio-recorded (if you so permit in the consent form in **Annexure B**) or noted down and the information will be kept in a password protected computer accessed by myself and my supervisor only and destroyed 3 years after completion of the study. Permission will be sought from you first if any direct quotes are to be included in the report. The data will be used to compile a PhD thesis through publications in scientific journals. A copy of the final thesis will be made available to interested participants and submitted to the Department of Water and Sanitation (DWS) Human Resources (HR) as required per the permission granted to conduct research in DWS (**HR Approval Letter Ref. 21766584**), and available through Rhodes library.

Potential Risks to Participation

To the best of my knowledge, participation in the study involves minimal risks, discomforts, and/or inconveniences that are no more than the risks, discomforts and/or inconveniences one encounters in daily living.

Potential Benefits to Participation

This study postulates that learning and/or co-learning amongst water resource practitioners in and across organizations involved in RDM interventions might surface new insights to offer possible solutions towards optimal execution of future RDM interventions. Insights into the extent to which such learning happens, and the extent to which it is utilized, will inform future initiatives. Your participation in this study will make a contribution towards unearthing these key learnings to inform recommendations for future interventions. Moreover, preliminary findings from the document analysis process will be shared with participants at the interview stage.

Confidentiality and Anonymity

Your participation in this study is entirely voluntary and anonymous. You have the right to withdraw at any stage without any consequence or future disadvantage whatsoever. Your contributions will be strictly anonymous. The recording of the interview will solely be listened to by me, for purposes of transcription. The information obtained in this manner is strictly confidential and will be utilized for academic purposes only. The data will be recorded and reported upon in a coded manner such that your name or any personal information that could be used to identify you is concealed.

The data gathered and any demographic information will be coded so that it will not be linked to your name. Your identity will not be revealed while the study is being conducted or when the study is reported in scientific journals and/or research reports. All the hard copies of the questionnaires/ interview notes that have been

completed will be stored in a secure place for three years, after which they will be destroyed. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. The information received during the project will only be used for research purposes and not be released for any employment-related purposes.

University Approval to Conduct the Study

The Research Education Higher Degrees Committee of Rhodes University have **approved** the formal study proposal, **Project ID 4889**, on **13 May 2021**. The ethics clearance was granted on **18 June 2021** and thereafter renewed annually. All parts of the study will be conducted according to Rhodes University accepted ethical principles.

Contact Details

The primary researcher, **Ms MD Thwala**, can be contacted during office hours on her cellular phone no. 082 966 2275 or email mmaphefothwala@gmail.com. The study supervisor, **Professor Eureka Rosenberg**, can be contacted during office hours at cell no. 082 739 4378 or emails e.rosenberg@ru.ac.za. Should you have any questions or concerns regarding the ethical aspects of the study, you can contact the Rhodes University Ethics Coordinator, during office hours at Tel +27 (0) 46 603 7727 or email ethics-coordinator@ru.ac.za.

Your participation in the study would be greatly appreciated.

Yours faithfully,



Ms Mmaphefo Thwala
PhD Scholar
Rhodes University
Environmental Learning Research Centre (ELRC)

Annexure A: Interview Questions

The below interview questions will be asked in a semi-structured interview setting. They have been informed by the findings of the Phase 1 document analysis process and guided by the theoretical frameworks of the study. A presentation will be provided at the start of the interview, to share the findings of the document analysis. As a key informant, you will have an opportunity to engage with these finding and you are invited to provide input based on your practitioner experience.

Table 1: Questions for Semi-structured interviews with role-players

RDM PROJECT MANAGERS ACTIVITY SYSTEM	
<u>Engagement with Document Analysis Factors</u>	
(a) Activity Systems (co-creation with role players)	
1. What tools are used to undertake RDM (Reserve, Classification, RQOs determination) projects? 2. What are the <i>objectives</i> and <i>outcome</i> of RDM determination? 3. What systems (rules) have been put in place to undertake the RDM projects? 4. Who are the role-players (subjects) involved? 5. Who are the community role-players involved? 6. How is the division of labour partitioned amongst all the role players-involved?	
(b) Document Analysis findings (resonance with experience of role-players)	
1. To what extent do phase 1 document analysis findings resonate with your experience of the RDM activity system? - Kindly provide any input/comments or thoughts on the information shared.	
(c) Role-player implementation experiences and associated learnings	
1. How long have you been working in your line-function? 2. Is there learning happening when we look at the last 10 years? 3. As a follow-up to question 1, what has been learnt by individual project managers/ project teams? give 1-2 examples of learnings. What lessons can be drawn from past RDM interventions? 4. How is this learning evident? Is there evidence that the problem has been better understood over time? 5. What learning processes and opportunities are available in RDM projects? What, if any, are there platforms and other opportunities for these lessons to be shared amongst practitioners? 6. What has been learnt about capacity building? how to attract, produce, use and retain the necessary skills for sustainable water ecosystems management through RDM? What has been learnt about up-skilling those already in the workplace? How is this learning evident? 7. Have any lessons from previous studies been carried forward in current studies? And how? 8. What has been learnt about translating policy into practical implementation? How is this learning evident? 9. What has been learnt about mobilizing resources for implementation? How is this learning evident? 10. What has been learnt about working together within organizations, and across organizations, to address the sustainable development and management of SA's freshwater water ecosystems? How is this learning evident?	
(d) Study-specific experiences of RDM role-players at head office level [applicable for both Case Study 1 (Mvoti to uMzimkulu) and 2 (Inkomati) RDM studies]	
1. What is the provision for handing over determined RDM outputs for implementation on the ground? How is this transition currently happening? 2. What information/data do you use and receive from other institutions with a shared water ecosystem management mandate? And Which institutions are these? 3. Stakeholder involvement and public participation is a key aspect of RDM processes, in your opinion is stakeholder engagement executed sufficiently in the process and what have been your learnings thereof over time? 4. Could you reflect and share some of the changes that you have experienced or observed in the RDM process in the last decade (2012 – 2022)?	

Annexure B: Consent Form

CONSENT FORM

I hereby confirm that I have been adequately informed by the researcher (Ms Mmaphefo Thwala) about the nature, conduct, benefits and minimal risks of the study. I have also received, read and understood the above written information. I am aware that the results of the study will be anonymously processed into research publications, and that these will be available to me. I understand that my participation is voluntary and that I may, at any stage, without prejudice, withdraw my consent and participation in the study. I had sufficient opportunity to ask questions and, therefore, I declare that I am above 18 years old and prepared to voluntarily participate in the study.

Please tick the appropriate box below

I agree to participate in the study:

Yes

No

I agree to being recorded (audio or notes):

Yes

No

Research participant's name: _____ (Please print)

Research participant's signature: _____

Date: _____

I, **Mmaphefo Thwala**, herewith confirm that the above participant has been fully informed about the nature and conduct of the above study.

Researcher's signature: _____

Date: _____

Annexure C: Permission to Conduct Research in DWS



water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Private Bag X313, Pretoria 0001 / Sedibeng Building, 185 Francis Baard Street, Pretoria
Tel: 012 336 7500 / Fax: 012 323 4470 or 012 326 2715

Enquiries: Ms Mirriam Moagi

Telephone: 012 336 7447

Reference: 21766584

Attention: Ms Thwala
Department of Water and Sanitation
Water Ecosystem Management
National Department

Dear Ms Thwala

The Department of Water and Sanitation (DWS) has granted you permission to conduct research in the department in pursuit of your studies in Phd at Rhodes University.

Your approval is granted based on the following topic: ***“Evaluating learning in water ecosystems management in South Africa: two case analyses of social learning among role players in resource directed measures.”***

Upon completion, you will be required to submit a copy of your findings to Human Resource Development (HRD).

Good luck with your studies.

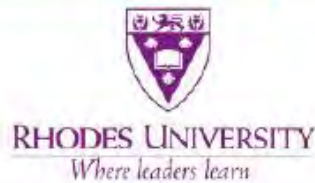
Kind Regards

Conrad Greve
CHIEF DIRECTOR: HUMAN RESOURCE MANAGEMENT
DATE: 2021/7/5



NATIONAL DEVELOPMENT PLAN
Our Future - make it work

Annexure D: Rhodes University Ethics Clearance Letter



Education Faculty Research Ethics Committee
Rhodes University
Education Building, Grey Street, Grahamstown/Makhanda, 6139, South Africa
PO Box 94, Grahamstown/Makhanda, 6140, South Africa
t: +27 (0) 46 603 8315
e: dean.education@ru.ac.za

19 June 2024

Ms Mmaphefo Thwala

g20t7953@campus.ru.ac.za

Dear Ms Mmaphefo Thwala

Re: Evaluating learning in water ecosystems management in South Africa: two case analyses of social learning among role players in resource directed measures

APPLICATION NUMBER: 2024-4889-8681

This letter confirms that your research ethics renewal application has been reviewed and **APPROVED** by the Education Faculty Research Ethics Committee (EF-REC).

Approval is granted for 1 year. An annual progress report is required in order to renew approval for an additional period. You will receive an email notifying you when the progress report is due.

Should any substantive change(s) be made during the research process, that may have ethical implications, you should notify the Education Faculty REC Chair via email. This includes changes in investigators. The REC Chair will advise as to whether a new application is necessary.

Do keep this clearance letter secure and accessible throughout your study and after its completion. It will be needed when a thesis is examined and when publications are submitted to journals.

Please also submit a brief report to the REC Chair on the completion of the research. This can be done via email. The purpose of this report is to indicate whether the research was conducted successfully and whether any ethics-related matters arose that the committee should be aware of, in order to guide future studies.

Sincerely,

Prof Mags Blackie

Chair: Education Faculty Research Ethics Committee

APPENDIX 6: ROLE-PLAYER EXPERIENCES ON ACTIVITY SYSTEMS FACTORS AND PRELIMINARY CONTRADICTIONS

Activity System	Role-Player Experiences on Activity Systems Factors and Contradictions
Interview Question: Kindly input on the activity system in terms of the tools, rules, subject, community, division of labour, object and outcome nodes.	
AS 1.1	AS1.1-RP1 and 2 • <i>Activity system accepted as an accurate reflection.</i> AS1.1-RP3 • <i>The RDM Project managers activity system is reflected accurately.</i> • <i>In terms of the rules in Activity System 1: the mandate for implementation of RDM on the ground is informed by the overall IWRM and the Catchment Management Strategy (CMS), where available. In the absence of a Catchment Management Agency (CMA), DWS has developed the Internal Strategic Perspectives stipulating this mandate for all WMAs.</i> AS1.1-RP4 • <i>The RDM Project managers activity system is reflected accurately.</i> AS1.1-RP6 • <i>The RDM managers activity system is reflected with all relevant elements; within the subjects node, role-players can be further broken down under PSC to Academia, WRC.</i> AS1.1-RP10 • <i>Instruments: add the Groundwater management strategy (National Groundwater Strategy, 2017)</i> Division of labour node: • <i>RO water practitioners for implementation of RDM outputs.</i> • <i>CMA Environmental Officers for implementation of RDM</i> AS1.1-RP10 • <i>These two bullets should merge as CMAs are currently being put in place to take over the implementation function.</i> • <i>What about SDS?</i> - <u>Researcher response:</u> <i>SDS appears as an new institution arrangement change as evidence of learning whereby a unit has been added to complete the water resource protection mandate (by focusing on the source) and one that is being required to conduct work in-house utilizing internal expertise.</i>
AS 2.1	AS2.1-RP3

Activity System	Role-Player Experiences on Activity Systems Factors and Contradictions
	<i>The activity system factors are captured accurately, being experienced in this work, and from your own personal experiences you have a good handle of all the factors at play.</i> <i>I'm impressed with the quality, the questions you have and how everything is formulated.</i>
AS 3.1	AS3.1-RP2 <i>Rules</i> <i>Catchment Management Forums</i> <i>Platforms for information dissemination</i> <i>Also platforms where officials collect specific information - stakeholders in these platforms possess on the ground know-how (knowledge)</i> <i>The Catchment Management Forums (CMFs) are run by Regional Office and Catchment Management Agency officers known as community development officers/experts.</i> <i>Communities are engaged by community officers first in cases where Control Environmental Officers (i.e. Adopt a River personnel) are running an initiative to train community members.</i> <i>Subjects</i> <i>Scientific Managers</i> <i>Scientists</i> <i>Scientific technicians</i> <i>Community Officers</i> <i>Control Environmental Officers</i> <i>Regulation Function Comprises of:</i> <i>Compliance (Includes RDM outputs implementation and compliance with these RDM outputs)</i> <i>Monitoring</i> <i>Enforcement [(remains one of the biggest challenges); (the enforcement function must ensure implementation of policy)]</i> AS3.1-RP3 <i>Tools</i> <i>Decision Support Systems for Reserve implementation</i> <i>Technical River Operation Committees</i> <i>Trans-Boundary Joint Water Forums</i> <i>Object</i> <i>To ensure that ecological water requirements as set in the Gazette and the international obligations are monitored for compliance.</i> <i>Rules</i>

Activity System	Role-Player Experiences on Activity Systems Factors and Contradictions
	- <i>Short term and long-term water resource planning decision support systems</i> - <i>Water Quantity monitoring (river flows)</i> - <i>Water Quality Monitoring for monitoring the status Quo</i> • <i>Subjects</i> - <i>Scientists (Water Resource Planners; Hydrologists, Groundwater, WQ Specialists, Vegetation, Macro Invertebrate and Fish Specialists etc.)</i> - <i>Edit CMA Environmental Officers to: CMA water practitioners because it is a variety of officials occupying different roles / titled differently</i> • <i>Community</i> - <i>Municipalities, Irrigation Boards, Emerging farmers, Sanparks, update as per inputs in the subject node above.</i> • <i>Division of Labour</i> - <i>The IUCMA has put in place fully capacitated functional institutional structures in the Planning, Water Quality and Compliance Monitoring & Enforcement (CME) units where teams conducting the work are specialized in hydrology, geology, water quality, habitat, biota etc. as per the components RDM outputs. These teams meet to integrate information, their observations on water resources (i.e. how biota responded to hydrological events).</i>
AS 3.2	AS3.2-RP1 • <i>Tools</i> - <i>Water Use Authorization, Assessment & Advisory Committee</i> • <i>Subjects</i> - <i>Delete Control Environmental Officers, there are various subjects who occupy different roles within the value chain</i> • <i>Division of Labour</i> - <i>Some responsibilities are shared with the the IUCMA and divided with them per boundaries in the Province</i> - <i>The Mpumalanga Office is currently operating as a Proto-CMA, the Olifants Proto-CMA and as such areas of responsibilities for the Mpumalanga Province are divided per the below demarcation:</i> ➤ <i>X-Region – IUCMA</i> ➤ <i>B-Region – Olifants Proto-CMA</i> AS3.2-RP2 <i>The activity system factors are captured accurately, I would just add the following to the instrument node:</i>

Activity System	Role-Player Experiences on Activity Systems Factors and Contradictions
	• <i>Tools</i> - <i>Source directed controls, including water use authorisation (Licensing)</i>
Interview Question: to what extent do the contradictions resonate with your experience of the RDM activity system?	
AS 1.1	Primary Contradiction: Lack of review provision for RDM outputs AS1.1-RP4 • <i>Comment: wrong information or errors cannot be easily corrected.</i> AS1.1-RP10 • <i>There is a pull between protection vs socio-economic development. Relaxation of protection measure that have been set can have a positive (economically beneficial) or negative (environmental degradation) effect.</i> • <i>Currently, the DWS is busy on the Amendment Bill, which incorporates the review of RDM outputs and specifies some time frames. I'm not sure if this belongs here but would be a lesson learnt brought about by stakeholders during various project meetings and consultations.</i> Primary Contradiction: Shifting object boundaries: WMA boundary amendments from 19 to 9 WMAs and recently 6 WMAs. AS1.1-RP10 • <i>Before the 6 WMAs, there was also consideration of converting into 1 CMA. These changes have mainly been political decisions with the changes of Ministers.</i> Primary Contradiction: Changing instruments – lack of standardisation of tools and approaches. • <i>Project managers don't challenge it because they don't have the required tools and skills to address it.</i> • <i>There is lack of trust of project managers' opinions, their scientific knowledge is not considered, nor trusted and their voice is suppressed in project platforms.</i> Secondary Contradiction: Division of labour vs subjects: technical tasks outsourced. • <i>Technical tasks are being conducted by consultant teams; staff members are being denied to be hands-on.</i> Secondary Contradiction: Division of labour vs outcomes: RDM managers support to provincial offices during implementation.

Activity System	Role-Player Experiences on Activity Systems Factors and Contradictions
	<i>Comment: The final product that is received by regional offices is through technical reports for which RDM project managers were not hands-on, the project managers therefore don't know what the technical output means.</i>
AS 3.2	AS3.2-RP2 <u>Primary Contradiction</u> <i>In the subjects node, there is resistance to release the RDM function to regional offices and CMAs as this would result in several factors:</i> <i>Release of official to function at regional and CMA local levels.</i> <i>Loss of power (e.g. DDG to CD to Director).</i> <i>Fear of implications that come with change as people (officials) are social beings.</i>

APPENDIX 7: ROLE-PLAYER FEEDBACK AND EXPERIENCES ON DOCUMENT ANALYSIS FINDINGS

Category	Role-player Experiences of Document Analysis Findings
Enablers	
Policy and Legislative	- Prioritization of water ecosystem protection is evident and specifications are included in key South African legislative documents. - Provision for water resource protection has consistently been made in key DWS policy, strategy and action plans: NWRS 1, 2, 3 and Master Plan AS1.1-RP4 <i>In addition to the above, RDM outputs are Gazetted.</i> AS1.1-RP6 <i>This prioritization is rightfully so, as the Reserve is the only right to water in the NWA</i>
Institutional	- DWS has a RDM Chief Directorate dedicated to water ecosystems protection (Reserve, Water Resource Classification and Sources Directed Studies Directorates) - enabling the water ecosystems protection functions to be carried out. - Retained over-time albeit changes implemented to the DWS organisational structure. - Cross-cutting water resource protection mandate - overlaps between DWS and other institutions (such as DFFE, SANBI) on water ecosystems management

Category	Role-player Experiences of Document Analysis Findings
	resulting in cooperative governance – data sharing among public sector institutions dealing with water resource protection to fill data gaps. AS1.1-RP8 <i>We have also experienced data sharing from private sector institutions; they offer data in project meetings. This would be captured as part of minutes of meetings and not acknowledged in relevant reports where this data may have been used.</i>
Operational	- Classification and RQO projects date to 11 years ago and Reserve projects even longer due to the pressing requirement for Reserves to guide available water quantity and quality for allocation during the WULA process. - DWS information systems in place for data management (WMS) AS1.1-RP4 <i>WMS does not have data. Data is fragmented, only available in some areas and none in others; or fragmented in terms of time periods. Regional Offices are not uploading data, data capturing is not taking place and as a result data ends up sitting on employees’ computers that are at risk of crashing” (AS1-RP4).</i> AS1.1-RP6 <i>WMS is there but it cannot be effectively used for RDM data storage. It is not assisting with RDM data. There is currently no platform to put raw RDM data, it resides with consultants and later on they don’t want to give it back. RDM needs its own system to store data such that over time one can track RDM (i.e. Reserves). Hence, the RDM Decision Support System was meant to address this issue, however that project is still facing challenges.</i> <i>Query: does WMS not only store WQ data? Does it also store flow data?</i> <i>We need a Water Resource Management Database</i> <i>Another challenge with WMS is the credibility of the data being collected and where those collecting it are appropriately skilled and accuracy.</i> - Where there is a CMA in place, stakeholder involvement and implementation is more robust (focused and efficient) - hence a functional Catchment Management Agency is core to implementation, community involvement and overall local water resource management. - DWS Monitoring Programmes such as the RQIS: River Eco-status (REMP) focus on the monitoring of the ecological conditions in river ecosystems – continuous monitoring is critical for data provision for informed decision making. AS1.1-RP8 <i>Data is provided from all other programs in RQIS as well. Hydstra system provides quantity data.</i>

Category	Role-player Experiences of Document Analysis Findings
	5. Involvement of NGO organisations is helpful for raising local issues at the technical level of RDM projects. 6. Implementation of RDM outputs at regional level through regulation programmes: water use authorisations, water allocation measures, SDCs/pollution prevention measures => decentralising functions enables community involvement and local water resource management.
Challenges	
Legislative and Policy	1. Lack of water legislation review and update. AS1.1-RP4 <i>RDM outputs are Gazetted</i> <i>Wrong information or errors cannot be easily corrected.</i> AS2.1RP3 <u><i>The lack of provision for interim targets</i></u> <i>There is no provision for a ‘work in progress target’.</i> <i>If a system is targeted for achieving a Water Resource Class I, an interim target would allow the entities that need to make it happen time to plan better for working towards the Class I; in terms of i.e. securing budgets which usually happens over a longer period.</i> OR <i>In situations where a Class III has been gazetted, a provision is need that although the overall Class will be kept at III, certain elements of the RQO could be stricter to maintain or improve those streams within the catchment that should be improved or maintained in their good conditions.</i> <i>As role-players / how do we make provision for the lessons</i> AS3.1-RP3 <i>The lack of provision for the review and update of RDM outputs makes amendments difficult when shortcomings are identified during implementation on the ground. The following challenges have been experienced on the ground:</i> <i>Following a drought (natural climate change event), the set RQOs in a water resource are no longer applicable due to changed system yield dynamics and the hydrology is no longer the same. Flexibility is needed for updating the set RQOs.</i> <i>Hydrology needs to be updated after 10 years – dynamics of the yields of the system change following climate change events</i> <i>=> flexibility is needed to accommodate changes – allow review flexibility</i> 2. Slow water sector implementation of policy commitments (PD-NF2-NWSF).

Category	Role-player Experiences of Document Analysis Findings
	- To date there are only two functional CMA in place, impacting negatively on local water resource management, including RDM implementation. 3. Reg.810 procedures (Step-by-Step RDM guidelines) are applied differently across project teams leading to lack of standardisation of approach, negatively affecting interpretation of outcomes. AS1.1-RP8 <i>I disagree with this factor, even where steps are not integrated, work completed will not be duplicated.</i> <i>We cannot expect standardisation of approaches from consultants if we (DWS) are not providing them with the tools to use. Regardless of which tools are used, provided that the outcomes respond to the intended objectives, it should not matter what tools were used or versions thereof.</i> 4. Also, resulting in inefficiency where Reg.810 procedures were not integrated in older projects. AS1.1-RP8 <i>Integration of Regulations 810 steps was merely for ease of having the steps in one.</i> <i>How the steps are executed by consultants or the methodologies used are not dictated because the tools are not provided by the DWS side.</i> 5. Disconnect in the translation of policies, strategies and RDM outputs into implementation tools and programmes (ID-PR1-WRC-TT 838/1/20) AS1.1-RP8 <i>The official transition from RDM determination to implementation is currently missing and it needs to be factored-in. Currently the RDM team works with the implementation team throughout the study process. Once the final output has been approved by the delegated authority, RDM office communicates with all interested and affected parties. Whether the term 'implementation' is appropriate is also questionable, perhaps 'monitoring compliance' should be used.</i> Overall challenge AS3.2-RP2 <i>The legislation addresses core sciences, the social aspects are not addressed. People on the ground don't relate to RDM nor understand it. It is too complex.</i>
Institutional	1. Complex Institutional Landscape - various institutions responsible for various aspects of water resource management (water resource protection included) Example: cross-cutting water resource protection mandate - overlaps between DWS and other institutions (such as DFFE, SANBI) on water ecosystems management resulting in misalignment of areas of responsibility

Category	Role-player Experiences of Document Analysis Findings
	2. Slow establishment of CMAs AS3.2-RP2 • <i>People think CMAs will be able to implement RDM and that is not so because they will just take over some functions of the Regional Offices/Proto-CMAs such as Regulation, Planning etc. The current institutional setup is not geared to deal with RDM and hence the resulting misalignment. The RDM function is currently not performed in the Regional Offices because it was seen as a centralized function at head office level. It will take time before the CMAs are fully functional and in some cases staff may need to be moved from Regional Offices, therefore people would need to be capacitated. As it currently stands, RDM is outsourced within DWS even at HO level, hence capacity to execute RDM is not available at all levels (HO and RO). Multi-expertise is needed at all levels and multiple tools.</i> • <i>Reserve implementation is currently happening incorrectly; and only the quantity component is being implemented from the point of view of operating rules (releases where there is a Dam or restrictions where there is over abstraction).</i> • <i>Monitoring vs Implementation of RDM are two different aspects.</i> • <i>Implementation requires assessment of the situation and putting management measures in place. This requires capacity (tools, expertise, funds). Capacity exists, but it lies elsewhere, with the DFFE within their Park Authorities and Conservation management divisions, however they also work within their boundary areas. Ironically the River does not conform to these boundaries.</i> • <i>Inter-relations between DFFE and DWS exist but we fail to see them. A Memorandum of Agreement (MoA) needs to be put in place or it must be captured in the legislation to enable action to happen for implementing RDM.</i> 3. Institutional structure for RDM • <i>Reserve, Classification and RQOs Directorates were initially separate, hence RDM projects were initially undertaken separately leading to misalignment and the lagging behind of other project areas in terms of having all Reserve, Classification and RQOs determined nationwide. Classification and RQOs units were later merged under one Directorate and this status quo prevails.</i> AS1.1-RP10 • <i>The interdependence of the work of the individual components of RDM (Reserve, Classes, RQOs) requires integration.</i> 4. Institutional Capacity Challenges • <i>Limited number of staff members undertaking the work to cover project areas nationwide for all catchments.</i> AS1.1-RP8

Category	Role-player Experiences of Document Analysis Findings
	<i>Considering the multi-year nature of the projects, it is appropriate to only conduct a few at a time to allow time to learn from each project; also, additional staff would be a cost addition that would be financially challenging with the current cost curtailment directives.</i> 5. Multi-expert teams required to undertake each project and team compilation internally would span across Chief Directorates rendering coordination challenges and challenges with limited skills. This has led to RDM projects being outsourced and undertaken by various project teams (Professional Service Providers) over the years resulting in different application of the procedures for determination of classes and RQOs. AS1.1-RP1 <i>There are challenges with coordination of capacity building in terms of the following:</i> <i>(a) Identification of participants</i> <i>(b) Allocation of capacity building areas of participation for identified capacity building personnel (AS1-RP1).</i> AS1.1-RP2 <i>It is not an issue of lacking skills, all expertise sought from consultants are available within DWS, however it is scattered everywhere in different Directorates.</i> AS1.1-RP10 - The challenge is lack of standardisation of outputs. <i>Gazetting template formats not the same across consultant teams</i> <i>Information included in the Gazette not the same.</i> <i>All of which lead to stakeholder confusion.</i> <i>Also, acquisition of data generated during the study is a challenge, consulting teams leave with it, until recently where Terms of Reference and Contract explicitly call for data submission to the DWS as a Deliverable.</i> 6. Separation of line functions - RDM outputs are implemented by regional offices within DWS, separate from the Water Ecosystem Management Chief Directorate that determines them leading to RDM outcomes interpretation and implementation challenges. AS1.1-RP10 <i>Evidence of learning in the activity system is the recent RDM implementation workshops that have been offering guidance to regional offices on how to implement RDM outputs.</i> - Role-player engagement in RDM workshops: to date majority implementation officials on the ground (provincial, proto/CMA) don't know or understand how

Category	Role-player Experiences of Document Analysis Findings
	RDM outputs should be implemented, and they face various challenges in this regard. Enforcement is undertaken under different units in DWS through regulatory mechanisms (i.e. Water use license conditions) – RDM outcomes interpretation and stipulation in WUL conditions remains contested by users (ID-PR1-WRC-TT 838/1/20)
Operational	1. Technical work components outsourced due to water resource management capacity challenges (PD-NF2-NWSF) (ID-SS3-IWQMS) (ID-SS2-NWRS-Ed2) AS1.1-RP6 • <i>At National Office level in a National Department, we develop policies, guidelines and strategies. It is not our role to perform technical work. There is only a handful of specialists within DWS that can run models and process Reserve Hydrological data. We don't have the required skills to run models; perhaps a few staff members in Planning might, however this is a significant gap.</i> - <i>As an example, qualified hydrologists, vegetation specialists are what is required which are not available in-house. These skills fit in Regional Office and not in Head Office where the focus is development of guidelines, strategies, policies etc.</i> - <i>Another example is execution of the revised desktop model, SPATSIM. Although officials were sent for training on this model they still can't use it.</i> • <i>Why are we not having people that can run models in Regional Offices to deal with Water Use License Applications (WULAs)?</i> • <i>Regional Offices should do their own comprehensive Reserves and provide all the data to Head Office. Head Office would still need to review and approve. Accumulative impacts need to be taken into consideration. General Authorizations (GA) get issued but they are hardly reviewed over time to determine if they are still environmentally sustainable.</i> - <i>As an example, an area that has an approved GA and later-on demarcated as an offset (rehabilitation, restoration intervention); how do we deal with ensuring that no more water is taken? This needs to be gazetted to ensure protection.</i> AS1.1-RP7 • <i>It doesn't make sense to still be outsourcing when there are technical personnel within the units. Initially, the aim of outsourcing was to address lack of experienced trained personnel; unfortunately, with time, the outsourcing continued as a norm; and once staff were in place, the request was for consultants to transfer skills. This issue is due to the following managerial challenges:</i>

Category	Role-player Experiences of Document Analysis Findings
	- <i>Unwillingness to put trust on personnel to conduct technical work.</i> - <i>It is due to these reasons that they resort to the narrative that personnel can't execute the work.</i> • <i>Consultants sometimes do not have required tools, they get assisted by DWS to obtain them; however, after work is completed, they leave with them. When requested to develop software, in the end they lock it and it doesn't actually work. DWS needs to make sure it benefits 100% from projects.</i> AS1.1-RP9 • <i>The institution is still reliant on consultants to conduct high confidence studies. There is still a reluctance by some senior scientists to do the RDM determination studies, hence actual work by the department is still mainly project management with insignificant scientific work, mainly related to review of documentation.</i> 2. Lack of funding impacts (as an example, inability to cover whole WMA for some studies). 3. Changes in WMA demarcations have led to exclusion of some catchments in some studies. AS3.1-RP3 • <i>The Usutu Catchment was added to the Inkomati area demarcation later, so it was not included in the Inkomati RDM project; as a result this RDM project is only underway now. Changes in demarcations leading to some areas left out.</i> • <i>The new added area will always be at the back-foot in terms of implementation efforts.</i> 4. Technical complexity of RDM hindering local knowledge of outputs in local institutions (such as CMFs within CMAs). 5. Municipal challenges: WWTWs impacting on water resources - cooperative governance needed between DWS and Municipalities. 6. RDM projects require input data, data gaps are a challenge that impacts negatively on the level of RDM projects that can be undertaken, resulting in low confidence outcomes. AS1.1-RP6 • <i>The impact of data inputs into the RDM results also impacts into other processes (i.e. WULA).</i> <u>RDM Implementation Challenges</u> 7. RDM Determination and Implementation executed at 2 levels – HO and RO respectively, affecting the interpretation of RDM project outcomes for incorporation into license conditions (WRC, 2018: Case Study on linking RQOs and Site-specific conditions).

Category	Role-player Experiences of Document Analysis Findings
	=> Disconnection between RDM determination and translation of outcomes into implementation programmes AS1.1-RP9 • <i>The issue is that the regulation functions pertaining/affecting RDM are not executed efficiently. It becomes a tick-box exercise and this is due to various factors including:</i> - <i>Regulatory functions being executed by personnel without the relevant expertise, such as administration persons evaluating License Applications without scientific background. They end up making the exercise an administrative tick-box exercise.</i> - <i>The lack of a process for moving from RDM determination to implementation to compliance.</i> - <i>The lack of tools such as real-time systems installed by IUCMA vs lack of knowledge results in all application being approved and ultimately over-abstraction of resources.</i> ➤ <i>All these factors result in a ripple effect.</i> AS1.1-RP10 • <i>There is a divide between provincial offices and national office directorates (in this case RDM). A ‘us and them’ situation – Regional office vs Head Office.</i> - <i>There is a need for understanding how we should be working together.</i> - <i>It is in the regional office mandate to implement.</i> AS3.1-RP3 • <i>There is a critical need for fully capacitated functional institutional structures in the Planning, Water Quality and Compliance Monitoring and Enforcement (CME) units. These teams need to be specialized in all the expertise aspects involved in RDM outputs (hydrology, geology, water quality, habitat, biota etc.)</i> • <i>NB: Similarly, the same multi-disciplinary Team expertise needed for RDM determination is needed for RDM implementation.</i> <u>Licensing Challenge</u> • <i>Where water quality loads limits have been set in a user’s water use license conditions prior to RDM project execution, they are found to be stricter than the set RQOs (which is less stringent). In such cases, the user will not comply with their license conditions arguing that they are adhering to the legal RQOs.</i> • <i>CMAs and Regional offices need to implement corrective measures.</i> 8. Thus far, there are only 2 functional CMA in place, impacting RDM implementation; Regional offices act as Proto-CMAs 9. Although regional offices take over the functions, the majority face capacity challenges (human resources and financial).

Category	Role-player Experiences of Document Analysis Findings
	AS1.1-RP7 • <i>It is fitting/appropriate that implementation should be at a localized level. However, what is needed is that implementation is conducted together between RO and HO officials in cooperation. This would assist them with ensuring accuracy of interpretation of RDM outputs. Regional officials might not have been apart of the team when documents were compiled and even in cases where they were involved, their contributions might not be reflected.</i> • <i>The challenge is that Head office is not available when regional officials need help. When stakeholders make enquiries, RDM staff members are not readily available.</i> - <i>This inaccessibility is prevalent even internally among staff members, emails don't have signatures for contact details; the directory doesn't in some cases doesn't have the full details of members.</i> - <i>This issue demonstrates lack of accountability.</i> • <i>Rotation of staff is needed, people become too comfortable and start taking work for granted the longer they stay in one place. Also, the longer they stay, the more they are unwilling to learn. They are resistant to change. In my opinion, the following managerial factors lead to these behaviours:</i> - <i>There is no managers training, it used to be there years ago but it got discontinued. Such a course would teach managers how to encourage staff, ensure managers put mechanisms in place that will effect conflict avoidance;</i> - <i>Poor management results in a lot of challenges that are being experienced;</i> - <i>Managers who are not accountable – in many instances mistakes are made (i.e. exclusion of critical information on Gazettes) due to budget cutting efforts; however, when stakeholders query this managers do not stand by their decisions; project managers get blamed for mistakes made while executing orders they were given by managers.</i>

APPENDIX 8: ROLE-PLAYER EXPERIENCES ON LEARNING

Activity System	Role-Player Experiences on Learning
Interview Question: Is there learning happening when we look at the last 10 years?	
AS1.1	AS1.1-RP1 and 2 • <i>Yes. However, learnings are residing with individual project teams/managers. There are no platforms for sharing these learnings for consideration of doing things differently for future projects.</i> AS1.1-RP3 • <i>Yes, how projects have been conducted in the past 5 years is very different from earlier, i.e. 10 years ago.</i> AS1.1-RP4 • <i>No, the work being conducted in-house is administrative. An example is the SPATSIM model where staff members were trained only on how to navigate in the model, what is needed is more than knowing how to click in the model; one ought to understand the back end of the system.</i> AS1.1-RP6 • <i>Yes.</i> AS1.1-RP7 • <i>Yes, there is learning, however it is minimal due to work limitation to administrative tasks; with technical components being outsourced. Technical staff members at their level engage with the details of work at an operational level, they see a lot of things when they go on site, stakeholders engage and share information with them, when all these matters are relayed to managers, technical staff members are not listened to. Over time technical staff members become despondent and no longer try.</i> AS1.1-RP8 • <i>Yes, on an organisational level.</i> • <i>No, on an individual level.</i> AS1.1-RP9 • <i>Yes, through capacity building programmes as well as on the job training.</i> AS1.1-RP10 • <i>Yes.</i>
AS 2.1	AS2.1-RP3 • <i>Yes</i>
AS 3.1	AS3.1-RP3 • <i>Yes.</i>
AS 3.2	AS3.2-RP2

Activity System	Role-Player Experiences on Learning
	• Yes.
Interview Question: As a follow-up to the above question, what has been learnt by individual project managers/ project teams? give 1-2 examples of learnings.	
AS1.1	AS1.1-RP1 and 2 • <i>Each project's Gazette outputs are designed differently; whereby each project manager works with templates provided by their consultant team.</i> • <i>Each consultant team's outputs format is different.</i> • <i>Regulations 810 procedures – each consultant team interpreting the guidelines differently and approaching project procedures differently.</i> • <u>Lesson:</u> <i>“We need to standardize our approaches” to avoid confusion</i> AS1.1-RP3 • <i>Comparisons can be drawn from projects conducted in the last 5 years such as Mzimvubu, Thukela and Mvoti RDM projects vs the earlier projects such as Olifants Doorn, Vaal and Olifants RDM Studies. Examples of learnings include the following:</i> (a) <i>The Gazette clearly stipulates and includes all components of water resources, which are:</i> - <i>Hydrology (quantity)</i> - <i>Water quality</i> - <i>Habitat and</i> - <i>Biota</i> <i>In the past Gazettes, these elements were not structured together and they were not easily identified by users.</i> (b) <i>Over time, new terminologies have been adopted that were not in the Regulations 810, examples are TEC vs REC</i> (c) <i>The NWA stipulates that “all significant water resources must be classified”, it however did not define the meaning of significant and in the past this rendered other water resources left out of studies, such as Dams.</i> - <i>A change in this regard is that Dams are now added in studies, starting from the Croc-West RDM project onwards.</i> AS1.1-RP4 • <i>Only administrative learning is taking place, nothing technical.</i> AS1.1-RP6 • <i>RDM project managers are now able to guide consultants effectively, we are questioning outputs; previously consultant dictated everything.</i> • <i>We have also learnt that we need raw data in a format that can go into PESEIS database; example: FIFA (Fish + Vertebrates data).</i>

Activity System	Role-Player Experiences on Learning
	AS1.1-RP7 • <i>It is a big issue for project managers to have to manage work that they don't have practical experience with. Where technical components of the work were outsourced, managers will thereafter not understand the technical components that went into it nor the rationale behind it. Lesson: technical people need to start doing the work themselves.</i> • <i>One needs to be suitably qualified with relevant technical background to lead technical work. I have had experiences where Managers from policy background don't have an understanding of the technical environment on the ground, leading to a barrier for effective execution of technical work; negatively impacting on service delivery.</i> - <i>An example, I was once involved in a project on Wastewater Treatment Works (WWTWs) where we found them to be technically unfit (dysfunctional) due to age, poor maintenance and staff complement. Such intimate knowledge of technical challenges on the ground is invaluable as one will be in a position to understand the intricate interactions between ecological drivers and responses impacting on i.e. instream habitat and water quality. We ought to have the technical know how to manage water resources effectively.</i> • <i>Human resources should be recruited and appointed in terms of suitability of qualification and experience and not based on gender, race or political affiliation. It should be about fitness to hold office.</i> • <i>In order to execute high confidence RDM studies, functional models are needed. We need to develop adaptable models for long periods to cater for technological software updates and changes. An example is that in the past the Rivers Database was very good and used effectively; now there is the new version of SPATSIM which doesn't work on older machines; so even if one was trained and knew how to use it, the machine would not be compatible.</i> AS1.1-RP8 <u>Organisational level</u> • <i>On an organisational level we are learning the importance of cooperative governance. Internally, we are learning that we need to work as Teams and cooperation is needed between the different Directorates as our work is interlinked. As an example data collected by RQIS is critical for feeding into an RDM projects; similarly as Reconciliations projects conducted in Water Resource Planning are critical in RDM projects.</i>

Activity System	Role-Player Experiences on Learning
	<i>Internally, we are all interlinked, however we don't fully understand how we each fit in the puzzle as a whole. Given that we are responding to many things, we need a central hub where it all comes together; and to teach each other on how the respective roles of our individual units fit into the puzzle. An example is the importance of water ecosystems management in the ultimate water service provision; if water resources are not protected/conserved; there will be no water for water services provision.</i> <i>There is a need internally to understand how the work components are interlinked. As an example, Water Ecosystems Management vs Water Services. Without healthy water resources, we cannot deliver drinking water.</i> <u>Individual level</u> <i>On an individual level, people are not learning due to individual factors such as 'the lack of willingness to learn'. In the past, there has been initiatives to start building specialization within team members (i.e. by component or by water resource); however, people were unwilling to take up the initiative and overall unwilling to grow.</i> <i>In order to learn at an individual level, one must want to grow.</i> AS1.1-RP9 <i>Scientists can conduct Reserves on their own. They can determine the quantity and quality component of the Reserve as well as determine the BHN component in a given catchment. This can be done for rivers, wetlands, estuaries as well as groundwater.</i> AS1.1-RP10 <i>In the past, staff members didn't have experience on managing projects because Scientific Managers were the dedicated Project Managers. That has changed positively, where now majority of staff members have experienced Project Management roles and learned key skills from compiling Terms of References (ToRs), project coordination, tracking deliverables / project progress and the project technical process.</i> <i>Officials were also given opportunities to attend various conferences, symposia and trainings which exposed them to new knowledge and technologies, thus enhancing capacity within. However, this has dwindled with time due to perpetual cost-cutting measures within government space.</i> Researcher follow-up Question: <i>what brought about this change?</i>

Activity System	Role-Player Experiences on Learning
	• Suddenly there were more projects and we (the supervisors) came to a realisation that capacity is in place (although not experienced) and the work must just be distributed. We were forced to see things differently. The change was organic in that way. • Officials requested these trainings themselves which implies that they recognise areas that required enhancement for them to perform their duties.
AS 2.1	AS2.1-RP3 [Repeated in relevant sections] <u>Incorporation of RDM outputs / completed RDM studies in implementation tools</u> • The relevant RDM outputs details need to be included in key implementation tools such as the DWS Recon studies. The details of RDM need to be clear in Recon documents and not only a high-level mention. • Municipalities do not incorporate them in their tools. IDPs are silent on RDM. <u>RDM Outputs misalignment</u> • Some elements in the technical documents have been found to not match with the Gazette details. In such cases the Gazette information is used; however, this creates uncertainties as technical reports are meant to elaborate on the information one finds in the Gazette. <u>Possible solution</u> • The question is what should the outputs look like in implementation tools? • What are the outputs of RDM and how should they be implemented? • The practice implications of the outputs or a guideline into practice document is needed. These outputs would mean different things for different implementers; e.g. Monitoring programmes would consider different element, compared to an IDP. • A procedure is needed to determine how to utilize RDM outputs
AS 3.1	AS3.1-RP3 • A key lesson learnt is identification of implementing role-players who need to take the work forward on the ground. Once identified, they need to be provided with a full suite of the RDM outcomes and guided on how these should be implemented. • Post the Inkomati RDM project, once the outputs were available and the IUCMA as an implementer on the ground started working with the outputs to implement, the following factors/lessons surfaced: - The Gazette does not provide the full duration curve, only the 60 and 90 percentile which are not achievable under specific

Activity System	Role-Player Experiences on Learning
	<i>catchment circumstances => a full duration curve must be provided.</i> <i>- The final technical reports supporting the information in the Gazette were not readily available from DWS; the IUCMA in the end liaised with consulting Teams to obtain information.</i> <i>- Efforts must be made to identify the dedicated personnel who are responsible for implementation of the project outputs and a full suite of technical information needs to be provided to them.</i> <i>- RDM outputs information dissemination needs to be provided to the implementers on the ground; also the technical information needs to be explained to implementers; duration curves are not understood by all members.</i> <i>- There needs to be clarification of roles.</i> <i>- RQOs need to be linked to cross-border flows.</i>
AS 3.2	AS3.2-RP2 <i>• If you look at the early years, 2002, only rapid Reserve studies were conducted, and these were not as detailed as the studies we have now. Earlier studies were of low to very low confidence and subsequently decisions were made on low confidence information. The impacts of these decisions were huge leading to various paradigms such as a Rivers running dry due to decisions made based on low confidence information.</i>
Interview Question: How is this learning evident? Is there evidence that the problem has been better understood over time?	
AS 1.1	AS1.1-RP3 <i>• Over time the problem is being better understood, initiatives to integrate all the components of RDM studies have been adopted in the newer studies.</i> <i>• An example of inefficiency when RDM projects are not integrated is the Vaal RDM project, whereby Water Resource Classes were determined separate from the RQOs. When the RQOs consultant came on board, they couldn't use the outputs of the earlier classification study due to differences in approaches by the different consultants.</i> AS1.1-RP4 <i>• No tangible learning that can be pointed out from my experience.</i> AS1.1-RP6 <i>• We are now able to review technical proposals and can identify gaps.</i> <i>• Yes, the problem has been better understood over time but this doesn't help because DWS procurement processes are hindering efficient progress. Supply Chain Management (SCM) listing has inappropriate</i>

Activity System	Role-Player Experiences on Learning
	<i>service providers that are not accredited for the technical work required for RDM studies; hence when RDM procures technical consultants the procurement process is flawed.</i> - <i>The Team Composition and Experience should carry more weight; however, this is not the case. The cheapest bidder goes through regardless of these critical requirements (team composition and experience); as a result a project ends up with consultants that can't do the work.</i> - <i>SCM is more worried about BEE requirements than specialization.</i> - <i>The adjudication committee also needs to be appropriately experienced to participate; otherwise inappropriate scoring happens.</i> • <i>Moreover, there is no process for checking the quality of the work produced. Example, RDM outputs translated by a service provider, who checks that the (i.e. isiXhosa) translation was accurate?</i> • <i>The procurement process to appoint technical skills needs review.</i> • <i>Over time officials have acquired further education, there are increasing PhD holders which is an indication of accreditation in the field.</i> • <i>Project managers are managing bigger projects of (i.e. R20 million budget and up).</i> • <i>Specific Officials in the organisation are nominated for participation in sector specialist meetings, committees and forum. Officials learn and take their learning to these settings and back to the organisation.</i> AS1.1-RP8 • <i>Slow steps are taken, people learn as they do or undertake projects. The more they do, the better the understanding of the process which makes it easier to lead in other new projects.</i> AS1.1-RP9 • <i>The evidence of learning is in Team members leading RDM projects and integration of projects.</i>
AS 2.1	AS2.1-RP3 • <i>KZN has not implemented RDM outputs yet.</i> • <i>There are implementation challenges between CMA vs RO</i> • <i>There is a disconnect between the Regional Office and the Proto-CMA due to a misperception that everything needs to be implemented by the CMA. There are systems that operationally reside with the Regional office main account such as the Hydrological/Geohydrological and River Health systems; it needs to be operationally made clear that regional office</i>

Activity System	Role-Player Experiences on Learning
	<i>needs to conduct the work on these systems, and that they have a role to play.</i> • <i>Implementation requires integration between RO and CMA.</i>
AS 3.1	AS3.1-RP3 • <i>New approaches are being executed by the IUCMA. The IUCMA is currently looking into developing an Integrated Resource Status Report to report on the water quality vs quantity and how the ecosystem responds to factors. The IUCMA has learnt that they have done a very good job in terms of monitoring (both status monitoring and compliance monitoring) and now they need to report on this work in a manner that will be readily available. This report will cover current status vs observations: We are integrating quality and how the ecosystem responds to those changes because that is the implementation we are saying.</i> • <i>In addition, we need to review licenses to see if a catchment is in an ideal situation or tolerable zone, looking at duration curves.</i>
AS 3.2	AS3.2-RP2 • <i>The high confidence RDM studies currently being conducted are a sign of learning; whereby we are now able to make decisions that are based on high confidence information.</i> • <i>Over time a resource pool is being created, former staff members have been able to move even into the consulting space with their knowledge, indirectly facilitating information sharing and resulting in work integrated learning across the sector.</i>
Interview Question: What learning processes and opportunities are available in RDM projects? What, if any, are the platforms and other opportunities for these lessons to be shared among practitioners?	
AS 1.1	AS1.1-RP1 and 2 • <i>After all studies, there is a need for sessions to harvest learnings; a learning platform for articulating project element that worked well and those that did not; to inform future process; however, currently such a platform does not exist.</i> • <i>There is no platform for exploring lessons or learnings of previous processes.</i> • <i>The only platform for reflection so far is SCM forms that are filled at the end of projects.</i> AS1.1-RP3 • <i>There are plenty learning opportunities, the challenge is whether they will be taken up by staff members. As a project manager of several past RDM projects, I conducted project initiation tasks (i.e. literature review,</i>

Activity System	Role-Player Experiences on Learning
	<i>project motivation and compilation of ToRs), this information ultimately contributed largely to the status quo report which is one of the early outputs of projects.</i> AS1.1-RP4 • <i>When there are funded projects underway, learning opportunities are there, however, they are not taken up nor supported internally. Researcher follow-up on the above statement: why is that so?</i> • <i>Participation approval/permission lies solely with individual managers, or it is the individual manager's discretion. What I have observed over the years is the lack of consistency in the approach on certain things, examples:</i> - <i>Staff members allowed to attend fieldtrips in some studies and not in others.</i> - <i>Staff members allowed to participate in all project activities (i.e. Classification and Reserve) in some studies; however, in others they need to stick to the activities in-line with their unit mandate.</i> AS1.1-RP6 • <i>Rolling out Reserve Determination to Regional Offices by project managers.</i> AS1.1-RP7 • <i>Capacity Building sessions are included in RDM projects. Identified staff join consultant teams on fieldtrips to conduct field assessments. Such capacity building session are fruitful, by attending such fieldwork sessions or site visits staff learn about different assessments vs the tools that are needed to conduct them;</i> • <i>However, these learning platforms are made difficult by managers (area demarcations prevent people from participating in fieldtrips in areas outside their demarcations for funding reasons). Furthermore, employees within projects encounter travel challenges</i> - <i>Travel KM queries (actual route vs google maps).</i> - <i>Number of officials that may travel limited to 2 – RDM fieldtrips require more manpower than this; and safety must be considered.</i> • <i>Experience/exposure influences quality of work. We like shortcuts at the expense of quality.</i> • <i>The working environment is not conducive to learning, employees end up losing interest. All these issues lead to poor quality of work due to staff members not working freely.</i> AS1.1-RP8

Activity System	Role-Player Experiences on Learning
	• <i>Project managers have the opportunity to lead work activities and guide consultants; however, due to unwillingness or lack of dedication, they become negligent, over-reliant and fail to manage consultants. Their recommendation of project outputs then becomes questionable resulting in the manager unable to have confidence in quality of work being recommended.</i> • <i>People don't take initiative to solve problems; one must motivate themselves to conduct the work within the job they voluntarily took up.</i> • <i>Platforms are there during team meetings such as strategic planning session. An item has been included of the reporting template for reporting on 'lessons learnt' per project; however, no one reports on it.</i> AS1.1-RP9 • <i>RDM Workshops provided a platform for learning within the organisation. During these workshops, learning was in 2 ways:</i> - <i>Through RDM Team preparations and anticipation for session questions.</i> - <i>Consultations that were held with the IUCMA and KNP staff for sourcing information (such as load calculation and practical ways of implementing RDM)</i> • <i>These workshops provided a platform for National to Regional impact and they were conducted for all the regions. RO officials who had no prior knowledge of RDM processes in the end had an understanding of where WEM fits into the jobs they do.</i> AS1.1-RP10 • <i>In the past, staff members didn't have experience on managing projects because Scientific Managers were the dedicated Project Managers. That has changed positively, where now majority of staff members have experienced Project Management roles and learned key skills from compiling Terms of References (ToRs), project coordination, tracking deliverables / project progress and the project technical process.</i> • <i>Officials were also given opportunities to attend various conferences, symposia and trainings which expose them to new knowledge and technologies, thus enhancing capacity within. However, this has dwindled with time due to perpetual cost-cutting measures within government space.</i> • <i>Platforms for sharing learning include sector participation in symposiums, conferences etc.</i>

Activity System	Role-Player Experiences on Learning
	- Also internally, people interact among themselves on how to execute tasks. Where someone has undertaken a similar activity before, staff share with one another and overcome challenges on peer-to-peer basis. - Info sessions have been suggested in the past but not taken up due to power dynamics that exist in the activity system.
AS 2.1	AS2.1-RP3 - I am not aware of any platforms but it would be a good opportunity to have a symposium or a workshop to discuss and share lessons learnt. This should be documented and key areas of improvement identified with actions to streamline and improve areas of concern. - The process of RDM continually evolves as we learn and reflect on previous methods, etc. It provides for keeping abreast with latest approached.
AS 3.1	
AS 3.2	AS3.2-RP2 [repeated in stakeholder section] There are a lot of opportunities that exist, the studies need to involve communities. Currently as things stand information is merely shared with communities, I have never seen involvement of schools, community leaders. A lot of indigenous knowledge systems lie with them, and this knowledge is currently not being integrated.
Interview Question: Have any lessons from previous studies been carried forward in current studies? And how?	
AS 1.1	AS1.1-RP3 - Yes, the following lessons have been carried forward in current studies: - Improvement of outputs formats over time. - Inclusion of Dams as part of significant water resources. - Integration of RDM studies for all Reserve, Classes and RQOs to be undertaken concurrently. AS1.1-RP4 - No. AS1.1-RP6 - Yes, each Operational Plan (OP)/ Business Plan (BP) has been informed by lessons from the previous OP. Planning for deliverables/annual targets is informed by how things worked in the previous cycle. This has also educated us on how to deal with force majeure events outside our control (i.e. natural disasters, can't sample during floods) on how to amend contracts and targets. AS1.1-RP7

Activity System	Role-Player Experiences on Learning
	<i>We are failing dismally on this part. RDM roadshows for capacitating regional offices have been undertaken in the past year, however, there are no reflection sessions thereafter to derive learnings or understand the challenges of each region. Regions are not the same and we learn new things with each one visited.</i> <i>The issue is that we focus on urgent current tasks and do not take the time to reflect on the sessions held.</i> AS1.1-RP9 <i>Yes, as we encounter challenges and problem areas we learn from these experiences and where possible apply them in future studies.</i> AS1.1-RP8 <i>Teamwork is critically needed in order to effectively achieve the common objectives of the job.</i> <i>The sooner all members involved can own the challenges and transparently reflect on lessons learnt per project; the sooner all members will learn.</i> AS1.1-RP10 <i>Yes, lessons in relation to project management, shortcomings of capacitation approaches within projects, etc. The TORs and Contracts with consultants have been strengthened in these regards and included specifics where there were loopholes. Project managers, through their supervisors also monitor the execution of these requirements.</i>
AS 2.1	AS2.1-RP3 <u><i>Lesson from the Mvoti project</i></u> <i>Technical documents post the project showing differences to the information gazetted and by that time the consulting teams have exited</i> <i>The project only produced a high-level implementation plan. The challenge is to take the output of the Mvoti and create a working implementation tool in place, considering elements such as site accessibility that might have changed since the completion of the project. The period between determination and implementation is important; the longer this period is, the more aspects might have changed on the ground, e.g. accessibility of sites.</i> <u><i>Lessons carried over to the Thukela project</i></u> <i>The exact information about monitoring sites, their locations, coordinates etc. and what should be monitored was provided.</i> <i>It needs to be made clear that the RQOs can't be taken and put as license conditions.</i>

Activity System	Role-Player Experiences on Learning
	Over time the organisational learning is evident in the sense that the Thukela Study developed an Implementation plan to guide the Region on focus areas and actions.
AS 3.2	AS3.2-RP2 We have learnt that gaps exist, but over time there has been improvement. From my LIMCOM participation, I have seen that other countries (Swaziland, Mozambique etc.) are learning from us on how to implement the Reserve.
Interview Question: What has been learnt about mobilizing resources for implementation? How is this learning evident?	
AS 1.1	AS1.1-RP1 and 2 - Implementation is mandated to regional offices in terms of the institutional design, however, during the course of the RDM project regional office personnel are sometimes not fully involved, or their involvement is secondary with limited interest; as personnel have core functions being prioritized. This presents a challenge for implementation later, in terms of understanding of RDM project outcomes. AS1.1-RP3 - Organisational prioritization of implementation action is a pre-requisite to mobilize resources for the activities. In the past, RDM implementation initiatives were not strong; as a result, in the RDM interpretation initiative being conducted with all Regional Offices, staff have indicated the following factors that hinder implementation of RDM outputs: - Human resource capacity challenges due to staff-turnover and budget constraints. - Complexities of the process in determining how the outputs translate into license conditions. <u>Evidence of learning:</u> - Now development of models to assist with interpretation of outcomes being considered. - A new Annual Performance Plan (APP) target on compliance to RQOs has triggered new activities for the RDM compliance monitoring which has led to initiatives to monitor RDM compliance and RDM interpretation workshops on the application of RDM templates by regional offices. AS1.1-RP4 - Resources are not there to mobilize implementation because they have not been built over time. AS1.1-RP6

Activity System	Role-Player Experiences on Learning
	<i>Financial challenges or inter-departmental rules on staff travel are impacting on execution of work. Currently, only 2 people are permitted to go to site (fieldtrips) which doesn't suffice for execution of the work as it is impossible for 2 people to conduct a rapid reserve; and also risky from a safely point of view.</i> <i>Work functions are not being sufficiently resourced, relevant expertise needs relevant qualified people.</i> AS1.1-RP7 <i>RDM Roadshows are a good initiative. Why are consultants not included in these roadshows? As the people that executed the technical work, they should be included too.</i> AS1.1-RP9 <i>There is a general hesitation or lack of will by Regional Offices to implement. This is understood as they face challenges related to capacity (financial and human). However, working in partnership with other stakeholders in the sector does assist, e.g. SANParks, SANBI, provincial conservation authorities, municipalities, WUAs and CMAs.</i> AS1.1-RP10 <i>Protection measures have been determined and set for most catchments in the country, but implementation and monitoring of implementation has been slow due to scarcity of human and financial resources in ROs. But the DWS is attending to that now in terms of CMAs establishment. Very few of RDM measures are being monitored, not to mention those implemented.</i> <i>I cannot say with certainty that anything has been learnt here because mobilization of resources is only now starting to take shape with CMAs being established.</i>
AS 2.1	AS2.1-RP3 <i>In KZN, the implementation process has not started. We have not started monitoring.</i> <i>There is disconnection and lack of clarification of roles and responsibilities between the Proto-CMA and the Regional Office. I have just received a document on 05 June 2023 that outlines the roles and responsibilities of Head Office vs Regional Office vs CMA. It looks like River Health is to be implemented by the CMA.</i> <i>Concurrently the WDSCS is meant to be implemented – The relationship between WDSCS and the RQOs. WDSCS will be implemented in areas where there are water quality concerns but also where the RQOs are stressed or exceeded.</i>

Activity System	Role-Player Experiences on Learning
	• <i>Clarification of roles and responsibilities is needed for ensuring smooth operational dynamics.</i>
AS 3.2	AS3.2-RP2 • <i>The sustainability of CMAs must be assessed by accountants. As an example, the Limpopo/Olifants CMA is irrational, the areas is to huge and impractical.</i>
Interview Question: What has been learnt about working together within organisations, and across organisations, to address the sustainable development and management of SA's freshwater water ecosystems? How is this learning evident?	
AS 1.1	AS1.1-RP3 • <i>Information internally within DWS as an organisation is available, in many cases various studies have been conducted in management areas or in some cases are undertaken concurrently. The challenge is coordination in terms of data sharing among these studies to avoid duplication of efforts.</i> - <i>An example is the Fish to Tsitsikama RDM project vs Algoa WULA project vs V&V process that were undertaken in parallel; the consultants in the RDM project ends up conducting a desktop study as information is available from the other 2 processes.</i> <u><i>Evidence of learning:</i></u> • <i>WMS is now being used even more than before for reconciliation of data due to the APP target on compliance to RQOs</i> - <i>Gazetted parameters are aligned with RQIS WMS parameters</i> - <i>WMS data is utilized; RQIS monitoring points are used in the RU prioritization stage to avoid duplication of efforts.</i> AS1.1-RP4 • <i>Collaboration needs to be supported by the organisation in order for efforts to be made to take up opportunities.</i> AS1.1-RP6 • <i>With learning the trade, you realise gaps within your own institution and sister organisations. All institutions under the National Government have their own challenges of coordinating different functions.</i> AS1.1-RP7 • <i>There are interlinks both internally within the different units of DWS and across different organisations in the sector. This calls for cooperation in working together to achieve the broader goal of sustainable water ecosystem management.</i> AS1.1-RP8

Activity System	Role-Player Experiences on Learning
	<i>We all want what 's best for our water resources. Working with catchment stakeholders bring the wisdom of what goes on in the catchment vs the history behind. This helps in understanding the current status and navigate towards setting protection measures that will allow the resource to thrive by providing the expected goods and services that users derive from it.</i> AS1.1-RP9 <i>As an example, with the strides that have been made by the IUCMA, one would expect the Mpumalanga Regional Office to be leveraging from them and benefiting from them. Evidence of working together is not visible.</i> AS1.1-RP10 <i>Working together within ensures optimal deployment of resources and avoids duplication of work. Externally, this ensures that the water sector is in the same page regarding challenges related to water resources. To some level, it assists with mobilization of funds to undertake projects of necessity, outside of government financial resources.</i> <i>In almost all projects, the DWS involves stakeholders, and affected and impacted parties. Over the years stakeholders have come to the party because they can observe deteriorating water quality and over-abstraction locally and they want to bring those to the DWS' attention, mainly through platforms such as project meetings and different forums.</i>
AS 2.1	AS2.1-RP3 <i>Regional authorities need to work in an integrated manner for greater impact. It is evident that various units within DWS (RO vs Proto-CMA) vs Municipal institutions are focused on their own mandates; and efforts are not aligned, evident in the lack of implementation to date.</i> <i>What is needed:</i> <i>Clarification of roles and responsibilities</i> <i>Articulation of implementation actions and clear demarcation of roles and responsibilities</i>
AS 3.2	AS3.2-RP2 <i>Some organisations have policies that do not enable data sharing (data security and cyber security in place). They end up sharing data only where it cannot be avoided when they apply for WULs.</i>
Interview Question: What information/data do you use and receive from other institutions with a shared water ecosystem management mandate? And Which institutions are these?	
AS 1.1	AS1.1-RP3 <i>SANBI NFEPA data</i>

Activity System	Role-Player Experiences on Learning
	AS1.1-RP4 • NFEPA - Biodiversity priority areas and ecological status • ARC – Hydrology • Stats SA – population surveys, census AS1.1-RP6 • NFEPA data – SANBI • NWRS • Reconciliation Studies Data – Water Resource Planning Directorate AS1.1-RP7 • Internal - <i>Water Quality Planning – surface and groundwater planning information</i> - <i>Licensing</i> - <i>Hydrology</i> - <i>Information Programmes – data systems (i.e. NIWIS) and annual reports (National State of Water)</i> • External - <i>South African National Biodiversity Institute (SANBI)</i> - <i>Department of Forestry, Fisheries and Environment (DFFE)</i> - <i>South African National Parks (Sanparks)</i> AS1.1-RP8 • <i>Mainly water quality data and ecosystem health. Due to the Protection of Information (POPI) Act I don't think it is safe to provide names of organisations without their approval. I will therefore skip this one.</i> AS1.1-RP9 • <i>SANBI and SANParks, biodiversity data related to freshwater ecosystems particularly the National Biodiversity Assessments, NFEPA data, Critical Biodiversity Areas, Reporting on Chapter 12 of the NWRS (Protection of Ecological Infrastructure).</i> AS1.1-RP10 • <i>Data and information on status of rivers, wetlands, estuaries and groundwater. So, it could be monitoring data and research outputs.</i> • <i>These institutions include DFFE, DMRE, Research Institutions, SANParks, other Conservation areas, academic institutions, WRC, NGOs, etc.</i>
AS 3.2	AS3.2-RP2 • <i>Some organisations have policies that do not enable data sharing (data security and cyber security in place). They end up sharing data only where it cannot be avoided when they apply for WULs.</i>

APPENDIX 9: ROLE-PLAYER EXPERIENCES ON CAPACITY BUILDING

Activity System	Role-player Experiences on Capacity Building
Interview Question: What has been learnt about capacity building? how to produce, attract, use and retain the necessary skills for sustainable water ecosystems management through RDM? What has been learnt about up-skilling those already in the workplace? How is this learning evident?	
AS 1.1	AS1.1-RP1 and 2 • <i>Capacity building coordination is a challenge in studies, there is a need for identification of participants upfront and their areas of interest for capacitation to ensure that only relevant members participate in fieldtrips and ultimately to ensure productive sessions.</i> • <i>The effectiveness of capacity building is dependent on the willingness of consultants to train.</i> • <i>There is not enough tiered/capacity building for specific needs, i.e. SASS\ <u>Needs</u></i> • <i>Project Managers need to sit in and participate for all the steps in the process</i> • <i>The capacity programme needs to be formalized to define exact areas of training and candidates for participation.</i> AS1.1-RP3 • <i>DWS Project Managers participation in consultant field work is key for knowledge and experience of factors on the ground (e.g. pollution sources; wetland vegetation i.e. presence of indigenous species informing one about the quality of the water) and processes followed by the consultant team. Project managers that take up capacity building opportunities and go out on fieldtrips and surveys (e.g. Hydrosensus) with the consultant teams gain capacity that enables them to understand and engage with the project outputs, reports etc. as they understand the process that led to the content of the reports.</i> • <i>Evidence of learning: in recent studies capacity building and mentorship programs are improved. I was able to complete my MSc and now enrolled for PhD as a mentorship initiative linked to the RDM projects I have managed. This is as a result of my drive as an individual supported by the organisation.</i> AS1.1-RP4 • <i>Capacity challenges are ongoing in DWS because the organisation does not trust its employees to conduct work. Consultants are hired even where expertise is available in-house. An example is Water Quality</i>

Activity System	Role-player Experiences on Capacity Building
	<i>whereby DWS are sampling for physicochemical variables (temperature, Ph, Dissolved Oxygen and Turbidity) and Diatoms and E.coli samples are sent to laboratories by DWS. These results are used to compile the State of Rivers report in-house. Consultant teams also draw from the same information. An example of a variable that could be hired for is Geomorphology.</i> • <i>Capacity building intentions are included in terms of references for projects; and excellent capacity building plans are drafted in project inception reports, but not actually supported.</i> AS1.1-RP6 • <i>Integrated projects (Reserve, Classification and RQOs) have provided a platform for learning from each other. There is cross-pollination between these processes now and we are learning from each other and it have created a platform for communication.</i> • <i>Project managers now have hands-on involvement in projects.</i> • <i>Several factors contribute to ongoing capacity challenges including:</i> - <i>Inability to execute technical work,</i> - <i>Lack of in-practice experience,</i> - <i>Unwillingness (lack of dedication to the trade), and entitlement issues;</i> - <i>Lack of technical components for working out WQ loads in the regional offices.</i> • <i>The recent roll-out of RDM implementation workshops for regional office capacitation are inefficient because they are theoretical and not practical.</i> AS1.1-RP7 • <i>Capacity building efforts are not working. In some instances, staff are available to assist/participate in projects but they are not allowed (excluded by Managers) due to demarcation of staff per area. Financial limitation reasons are given for this.</i> • <i>Capacity building is inadequate – there is minimal learning due to staff not being given real work (technical functions are outsourced).</i> • <i>In addition, functional tools are needed to execute the work, these include functional models.</i> AS1.1-RP8 • <i>It is challenging to upskill those already in the workplace if they themselves are unwilling to learn. Unwillingness is evident when project managers don't take the responsibility to draft their own capacity building plans indicating exact components they would like to learn</i>

Activity System	Role-player Experiences on Capacity Building
	<i>within a project. Expecting consultants to draft these results in a programme that does not address individual capacity building needs.</i> • <i>Capacity Building opportunities are there, it is up to the staff members to take them up in a manner that will align with their career ambitions.</i> • <i>Institutional factors play a role. As an example, the Department initiated the Graduate Training (GT) programme to address skills shortages/gaps. However over the years the GT programme has been implemented differently; GT's used to be allocated to various units of DWS with their own budget from Learning Academy; currently with the Learning Academy expecting hosting units to fund the remunerations of GT results in the inability to retain them.</i> AS1.1-RP9 • <i>Knowledge management is still lacking. Although there are numerous manuals developed on how to conduct certain studies, there are still no SOPs in place to assist new incumbents on business processes asap. Furthermore, there is still a mentality of people keeping information to themselves, especially training manuals etc. This is not shared at a central portal for all to access.</i> AS1.1-RP10 • <i>There are changes in how Capacity Building was handled before and now. In the past CB was not factored into projects. Now it is included as a requirement in the ToRs and incorporated in the project plans (i.e. Inception Reports).</i> • <i>Furthermore, CB inclusion is now being divided into mentees and general CB for upcoming projects. Such that mentorship should be integrated into the project with mentees allocated tasks to complete for the project. CB candidates will now be required to conduct tangible work and contribute to the study.</i> • <i>This is aimed at timeously assessing and evaluating learning and measuring work quality.</i> • <i>Researcher follow-up Question: what brought about this change?</i> • <i>We had cases of staff complaining about exclusion in activities by consultant team members in the field. Where CB DWS would end up spectating and not actually doing the work.</i> • <i>DWS staff have also only been subjected to general CB which would be a 3-day training or a workshop here and there, etc. At the end of the project officials would still be unable to conduct these activities independently.</i> AS1.1-RP11

Activity System	Role-player Experiences on Capacity Building
	• <i>Most of the training interventions are delivered through external service providers owing to a lack of capacity internally.</i> • <i>DWS has Regional Skills Development Committees and National Skills Development Committees whose main duty is to ensure alignment of the training with the organizational strategic objectives/goals.</i> • <i>HR training courses fall under transversal interventions (training that applies to all employees, e.g. computer training, project management) or technical training (training that is job specific e.g., Hydrology; Water Management).</i>
AS 2.1	AS2.1-RP3 • <i>Internally it would be great going forward if DWS staff are seconded to work alongside the consultant in their respective areas of interest. You learn by doing. The one or two training gives a broad overview but it is a lot to digest in a short period of time.</i>
AS 3.1	AS3.1-RP3 • <i>RDM work is very specialized and only specific groups of Professional Service Providers in the country are undertaking it. There is a concern regarding skills transfer. Training interventions have been executed over the years but not efficiently as the work entails specialization that cannot be transferred over a week long training course. In addition, a multi-expert team needs to be trained, capacity building needs to be executed to recipients per area of specialization.</i>
AS 3.2	AS3.2-RP2 • <i>There is now a realisation that we need to build capacity and be deliberate about generating the necessary work force. Capacity building is still focused internally, it needs to spread to even the ECD level.</i>

APPENDIX 10: ROLE-PLAYER EXPERIENCES ON STAKEHOLDER ENGAGEMENT

Activity System	Role-Player Experiences on Stakeholder Engagement
Interview Question: Stakeholder involvement and public participation is a key aspect of RDM processes, in your opinion is stakeholder engagement executed sufficiently in the process and what have been your learnings thereof over time?	
AS 1.1	AS1.1-RP3 - Stakeholder engagement is sufficient, the challenge is the scientific nature of the projects whereby even some academic stakeholders do not understand some contents. AS1.1-RP4 - Community stakeholders on the ground often don't possess water expertise; they only understand water supply challenges in relation to their lived experiences; or needs. - They, therefore, can't engage on RDM stakeholder meetings, they know nothing about the technical work being done. - Information to these stakeholder needs to be simplified in a form of citizen science. AS1.1-RP6 - Stakeholder engagement is not working properly. It would work better if those stakeholders that have and can use online platforms (i.e. Teams) could use it and participate. There are a few challenges with how stakeholder engagement is currently executed: - DWS provides platforms and opportunities for stakeholders to voice their concerns; however, the outcome that is derived from these sessions is later captured to say stakeholders agreed. - Stakeholders bring all water related issues to the sessions even the ones that are not the focus of the sessions (i.e. conflicts on water use license applications not approved) and they thereafter boycott the process during 60-day review period. - You find 2 extremes of stakeholders participating in the process: on the one hand it is members of the public who do not understand or know what the process is about; vs on the other hand, retired experts and NGOs who are well knowledgeable but disruptive, they participate to be auditive and come into the process with a pre-set negative mind. - A revised public participation guideline is needed for technical studies. AS1.1-RP8 - Yes, within the project we have various stakeholder meetings that we make provision for to ensure we leave no stone unturned. Furthermore, we rely on Provincial offices to convey the message to their catchment management forums. We also participate in other projects outside RDM where we provide information about the RDM projects.

Activity System	Role-Player Experiences on Stakeholder Engagement
	<u>Stakeholder engagement at forums</u> - RDM project managers no longer attend forums to engage stakeholders; they instead train regional officials on the RDM content to ensure they take the information forward. This has been beneficial in terms of: - Cutting costs - Capacity building for regional officials to understand project outcomes. AS1.1-RP9 - Learning needs to take place at community level as well. We need to develop tools to capacitate people on the ground. Community engagement should: - Take them through a process and - Embrace that the learning systems of deriving meaning are different. - Engage with things people value. - Ensure that we engage with people in a manner that has meaning to ultimately ensure water resource protection. - Citizen Science could assist in two ways: - Data provision. - Implementation of wise land-use. AS1.1-RP10 - No. Stakeholder engagement meetings with the general public are undertaken in the beginning of the study (to announce the project) and later in the study (to communicate project outputs). In between people are not consulted. Moreover, the audience that attend is always the similar crowd, such as NGOs, Environmental Institutions, Academia etc. Community members and the real people that are affected are not there, they do not come due to several possible reasons: - Complexity of the study content - Language barrier (the meeting doesn't usually include local language interpreters) - Lack of awareness - A contradiction here is that the process requires extensive stakeholder engagement to be conducted but the actual process does not adequately cater for this. Researcher follow-up question: why is this? - Response: Budget constraints. We are now budget orientated at the expense of key activities such as stakeholder engagement and capacity building; and even the studies themselves (area coverage, level of execution such as high confidence)
AS 2.1	AS2.1-RP3

Activity System	Role-Player Experiences on Stakeholder Engagement
	• <i>Participation within each organisation</i> - <i>A multi-disciplinary team of stakeholders needs to be engaged per organisation to ensure that all the elements of the RDM process are engaged with by the relevant staff members (such as hydrology vs water quality vs planning), one person is not a specialist in all aspects. This will assist in example, avoiding the exclusion of variable. AND, within each team, 2-3 representatives are needed to ensure continuity of the work and knowledge of the unit even in the event of staff turnover or relocation of a staff member that participated in the process.</i> • <i>Participation of key implementing entities and stakeholders</i> - <i>Municipalities do not participate in the RDM determination process, even though they are invited. This results in them not understanding the implications of the outputs.</i> - <i>Community members – engagement of community stakeholders is critical for ensuring land-care management practices and protection of water resource management tool (such as curbing vandalism).</i>
AS 3.1	AS3.1-RP4 • <i>During stakeholder engagement, it needs to be clear what stakeholders are being asked to participate in.</i> • <i>Sharing information with people is one thing and it is only a starting point for a certain purpose.</i> • <i>Knowledge sharing is another – people should be enabled to think what they should do with the knowledge.</i> - <i>We should aim for behavioural change</i> - <i>Explore how people learn</i> - <i>Get people involved</i> - <i>Avoid extractive processes</i> • <i>Implementing RDM requires implementation of catchment management through the CMS and that delivers the Reserve.</i> • <i>What is needed is a functional government structure to be put in place and the implementation of the catchment management strategies. Without that intermediary, catchment management and SDM are unlikely.</i>
AS 3.2	AS3.2-RP1 • <i>In the Olifants Proto-CMA, there is no implementation of RDM outputs so far, although the Gazette has been published for many years. We only put a statement in the license conditions about RQOs which stakeholders and CMFs have indicated that they do not understand – upon request to the RQOs office for them to come and present and explain to stakeholders, we were told that stakeholder consultation meetings</i>

Activity System	Role-Player Experiences on Stakeholder Engagement
	<i>(public participation) were conducted in the area and the office can only prepare a presentation to provide to the regional office staff to present to the CMFs.</i> <i>- I am a CME official, on the authorization side, I wouldn't be able to deliver such a presentation to the CMF.</i> AS3.2-RP2 <i>• There are a lot of opportunities that exist, the studies need to involve communities. Currently as things stand information is merely shared with communities, I have never seen involvement of schools, community leaders. A lot of indigenous knowledge systems lie with them, and this knowledge is currently not being integrated.</i>

APPENDIX 11: ROLE-PLAYER EXPERIENCES ON TRANSITIONING FROM RDM DETERMINATION TO IMPLEMENTATION

Activity System	Role-player Experiences on Transition from RDM Determination to Implementation
Interview Question: What is the provision for handing over determined RDM for implementation on the ground? Are there any processes in place for this? If not, how is this transition currently happening?	
AS 1.1	AS1-RP1.1 and 2 <i>• There is no handover process. A Gazette is published and the steps that follow in terms of implementation have to proceed from the published Gazette onwards, along with the accompanying technical reports. Implementation is not within the mandate of the CD: WEM.</i> AS1.1-RP3 <i>• In the past, there were no provisions or no process in place for hand-over; currently, the new RDM interpretation initiative of conducting regional offices roadshows is a start to a form of hand-over.</i> AS1.1-RP4 <i>• There are no provisions in place, once the process is completed implementers on the ground are expected to derive the information from project reports and Gazette information.</i> AS1.1-RP6 <i>• The recent RDM interpretation workshops to regional offices is not sufficient. One cannot train a complicated process in a few hours. Once</i>

Activity System	Role-player Experiences on Transition from RDM Determination to Implementation
	<i>this workshop is held with a regional office, people are informed and not capacitated.</i> <i>To learn, as an example, specialists (i.e. hydrologists) need to provide practical demonstrations, needs analyses must be undertaken. Also, data needs to be stored over a long period of time and verified to provide reliable information.</i> <i>Adaptive management needs to be applied.</i> AS1.1-RP8 <i>The transition from RDM determination to implementation is currently missing and it needs to be factored in. This results in the delay in monitoring the compliance to RDM outputs. Whether the term 'implementation' is appropriate is also questionable, one feels the urge to avoid using it.</i> <i>Internally, we are all interlinked, however we don't fully understand how we each fit in the puzzle as a whole. Given that, we are responding to many things, we need a central hub where it all comes together; and to teach each other on how the respective roles of our individual units fit into the puzzle. An example is the importance of water ecosystems management in the ultimate water service provision; if water resources are not protected/conserved; there will be no water for water services provision.</i> AS1.1-RP9 <i>We lack a process for moving from RDM <u>determination</u> to <u>implementation</u> to <u>compliance</u>.</i> AS1.1-RP10 <i>The recent RDM interpretation workshops to regional offices is providing a way of communicating RDM outputs to local implementers. Although, now compressed to a 1-day online session (previously 2 days on the ground with practical examples), it is better than nothing.</i>
AS 2.1	-
AS 3.1	AS3.1-RP3 <i>Lack of a process for ensuring handover of RDM outputs to implementation officials on the ground.</i>
AS 3.2	AS3.2-RP1 <i>There is no clear instructions on how to implement RDM outputs nor training.</i> <i>RDM outputs are just a gazetted document that is placed on the DWS website once the project is completed.</i> <i>There is no follow-up on implementation.</i> <u>Needs:</u>

Activity System	Role-player Experiences on Transition from RDM Determination to Implementation
	• People need to be trained on what the outputs mean and how they should be implemented. • Staff performance agreements should reflect RDM implementation activities.
Interview Question: What has been learnt about translating policy into practical implementation? How is this learning evident?	
AS 1.1	AS1.1-RP3 <u>Policy short-comings play-out operationally.</u> • Evidence of this is the lack of definition of ‘significant’ in the policy which led to the exclusion of Dams in earlier RDM studies. The matter was subject to interpretation from one project team to the next. <u>Slow establishment of CMAs</u> • Failure to establish CMAs has resulted in RDM implementation failure/challenges. AS1.1-RP6 • Some functions are developed and approved at national level for implementation at regional (local) level, an example is the management of estuaries. However, the functions don’t go with the funds and personnel that should execute. • An example is with estuarine management plans; expertise and funds are lacking which is a major detriment to environmental management. • Implementing officials should be involved in the development process, involvement in the stakeholder participation process is not enough for preparing for implementation – a transgressional/ sequential / transitional process is needed. As examples: - We write ecological specifications (Ecospecs) from a technical viewpoint, they put it as is in the water use license conditions, it becomes generic. - The scale of the RQO is too big for Ramsar level. We need a rule for Ramsar sites to be an IUA (for setting specific conditions). Similarly as done for Estuaries. AS1.1-RP7 • People are not familiar with policies/legislations/strategies at their fingertips in relation to the work they do. These are critical instruments that officials should readily know. It would be a great advantage to relate and apply them accordingly. • RDM is interlinked to many sections in NWA such as Chapter 14 (Monitoring systems) and Chapter 4. However, RDM officials tend to only focus on their area.

Activity System	Role-player Experiences on Transition from RDM Determination to Implementation
	<i>The threat is that despite all the water resource protection efforts to date, even sites that are supposed to be pristine are polluted. This information is evident in the monitoring data = hence there is a need for looking at the challenge holistically and not only focusing on RDM determination.</i> AS1.1-RP8 <i>The guidelines for the process provide guide for every step; once one fully understands the process they can't go wrong.</i> <i>The process factors-in available data (such as authorized; existing water use activities; various scenarios are considered including future developments), hence by the time RDM are set, they have taken into consideration all the catchment specific details and they are set in consideration of all of it.</i> AS1.1-RP9 <i>There are areas that are doing good work to implement RDM outputs: <u>Olifants</u></i> <i>The IUCMA has made many positive strides whereby they have:</i> <i>Installed real-time measurement tools against the Reserve to ensure there are alerts when there is not enough flow, this enables alerts to be sent out to Dam Operations to release water to cater for this.</i> <i>The Western Cape's Berg-Breede CMA on mountain catchment areas alien invasive clearing efforts yielding positive results in availing water.</i> AS1.1-RP10 <i>Policies/legislations have been interpreted in various ways over the years. The NWA specified for RDM measure to be put in place for 'significant' water resources. The meaning of significant has been interpreted in various way. As a result, earlier studies did not include Dams as part of water resources. This has since been addressed in recent studies => evidence of learning happening.</i> <i>Similarly, Groundwater was previously not considered as a viable alternative water source. Only recently with the intensity of water scarcity (i.e. Day Zero droughts, and 96% surface water allocation) and climate change impacts, when looking at future water needs. Groundwater contributes 16% to the total water supply currently, and therefore has become a viable option to tap into for allocation, if used sustainably. It has now been elevated to form part of a water mix in the country despite dry periods.</i>
AS 2.1	AS2.1-RP3

Activity System	Role-player Experiences on Transition from RDM Determination to Implementation
	• <i>Getting the message to people about what RDM outputs imply for them. There is significant implications once they are set.</i> • <i>Implementing authorities (i.e. Municipalities) do not understand the implications of RDM outputs for their operations. How they should incorporate RDM in their Municipal water infrastructure plans and IDPs.</i> • <i>Demonstrate what the implementation guidelines look like for the different contexts.</i> • <i>I have this one example which we are still trying to get consensus on whether to set a Class I or II for the IUA W11 as part of the Usutu to Mhlathuze Classification Study. The Matigulu Estuary is in a B/C with recommendation for a B which will also require an increase in MAR of 15%. However, there isn't any further information provided as to how the Region could potentially achieve this 15% increase. It needs to go one step further to look at how feasible this is to achieve. The DWS officials that attend the PSC meeting where this information was presented recommended setting a Class II as their feeling was that the increase required was not achievable. The specialists are now looking to determine if a Class I can be achieved by addressing non-flow and water quality impacts.</i> • <i>=> Stakeholder participation is critical; implementing authorities (i.e. DWS regional office) need to form part of such decisions to ensure that unrealistic goals are not set and that they understand the implications for implementation.</i>
AS 3.1	AS3.1-RP3 • <i>The challenges being experienced have nothing to do with the technical work, it all pertains to the institutional systems that have been put in place and whether they are being followed. As an example, there are water users that have historical existing licenses that were issued before RDMs were put in place. The users will be discharging loads that are exceeding limits and their justification is that they are permitted to do so in their license. Authorities need to review licenses after 5 years, now that RQOs are in place these licenses should be updated, however, this is not being done.</i>
AS 3.2	AS3.2-RP2 • <i>Policy must be backed by sound scientific basis.</i> • <i>Learning becomes evident when challenges arise i.e. as DWS we are hiring wrongly hence capacity challenges for implementation of RDM as example.</i> • <i>Our policies are not based on science.</i>
Interview Question: Could you reflect and share some of the changes that you have experienced or observed in the RDM process in the last decade (2012 – 2022)?	

Activity System	Role-player Experiences on Transition from RDM Determination to Implementation
AS 1.1	AS1.1-RP1 and 2 <i>The tools are constantly changing (i.e. models: FRAI vs FIFA; RIFS vs SPATSIM. Due to lack of standardisation, the tools used depend on the study management team.</i> AS1.1-RP3 <i>Same input provided in the learning section.</i> AS1.1-RP4 <i>Recent integration of studies</i> AS1.1-RP6 <i>Methods used to determine the Reserve have improved a lot in terms of confidence and application; moreover, specialists are more experienced and trained than before.</i> <i>The science is improving, and its interpretations are better understood.</i> <i>As an example, species presence informs opinion about the hydrology; interrelationships between abiotic and biotic factors – due to accreditation requirements (SACNASP and OSD) for continuous learning such that scientists can be held accountable for their outputs. Accountable for signing-off the studies – it forces responsibility on information we provide and sign-off.</i> <i>RDM stability, settlement of staff members staying in the unit longer. This enables corporate memory – experience learned over long period is preserved and applied in future processes; staying is a huge benefit. Employees apply what they learn. Although they may be line-function changes, knowledge still remains in the water sector.</i> <i>A scientific research unit is no longer available; the Water Research Commission is meant to fulfil that task, however priorities are not always aligned.</i> AS1.1-RP8 <u><i>Stakeholder engagement at forums</i></u> <i>RDM project managers no longer attend forums to engage stakeholders; they instead train regional officials on the RDM content to ensure they take the information forward. This has been beneficial in terms of:</i> <i>Cutting costs</i> <i>Capacity building for regional officials to understand project outcomes.</i> <u><i>Participation in study fieldtrips</i></u> <i>Group travel in project fieldtrips has been changed for the attendance of only those project managers involved in the study due to cost curtailment measure.</i>

Activity System	Role-player Experiences on Transition from RDM Determination to Implementation
	AS1.1-RP9 • <i>There is definitely an evolution in the methodologies to make the RDM processes more accurate and of a higher level. The work done for the department is conducted by highly qualified experts in the RDM field. The DWS team are competent in determining Reserves at a low to medium level of confidence and can conduct certain components as high level studies. DWS have certainly created confidence and comfort in the sector that the legal mandate of Chapter 3 (RDM) is being implemented.</i> AS1.1-RP10 • <i>Previously, projects were undertaken separately but now an integrated system has been developed and the projects are undertaken in an integrated manner starting around 2019.</i> • <i>Capacity building is now taken seriously, however departmental financial constraints are detrimental to capacitation programmes.</i> • <i>Scientists have built confidence in managing projects from inception to close-out, thus enhancing capacity and capability within the CD: WEM.</i> • <i>Inclusion of the water sector at large in our activities ensures collaboration where resources are inadequate from the DWS, e.g. Cape Nature does some monitoring of RQOs where Western Cape RO is unable to due to scarce resources.</i> • <i>CD: WEM is developing a Decision Support System which will assist with archiving of RDM outputs because previous studies lost a lot of crucial data and information since outputs resided with project managers, and the filing system was not up to scratch.</i>

APPENDIX 12: ROLE-PLAYER EXPERIENCES ON IMPLEMENTATION OF RDM

OUTPUTS

Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
Interview Question: What are your experiences in terms of implementing RDM? What lessons can be derived based on these experiences?	
Overarching	AS2.2-RP2 • <i>Through the coordination of RDM Implementation workshops role, the following lessons have emerged from the session held with the following regional offices.</i> <u>Limpopo</u> • <i>Monitoring does not reside in one component/unit;</i> • <i>Compliance monitoring resides within another Directorate as opposed to being part and parcel of the component mentioned in bullet 1 above; there is therefore a challenge of data consolidation;</i> • <i>Shortage of personnel in relation to work that must be performed; only 12 officials dealing with all the work; and</i> • <i>Various trainings coming separately to the Regional Office: WMS, RDM, RDM Compliance.</i> • <i>As personnel from authorization unit, their challenge was on Groundwater Reserve Interpretation, however the presentation provided earlier on gave clarity on various issues of uncertainty and was confirmation that they are on track;</i> • <i>A Surface Water Reserve is a complicated document – Regional Office is not sure where to extract the relevant variables;</i> • <i>Reserve interpretations are not clear;</i> • <i>She added that she will engage the RDM Team on whether other tools such the National Water Resource Strategy and Internal Strategic Perspective (ISP) may be used in addition to those presented on. From literature, the ISPs are useful tools to provide the following information:</i> - <i>Scenarios for population growth and initial estimates of possible future water requirements. The water use licence authorisation officials may to a certain extent use the scenarios to check water availability in the catchment;</i> • <i>Reconciliation of water requirements and available water are documented in the NWRS. The information on water availability is provided at the catchment scale and in some instances the Water</i>

Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
	<i>Management Areas (WMAs) are further sub-divided into sub-areas or components.</i> <u>Mpumalanga</u> • <i>There is no monitoring of the Reserve for the DWS, however, the IUCMA has few initiatives to manage the flows;</i> • <i>There is already a deficit in terms of the quantity component of the Reserve.</i> • <i>It was suggested that there should be mapping and overlaying of the granted information from the Water Use License onto the PES/EIS information;</i> • <i>The DWS Planning Unit from Head Office should be onboarded to assist the regions with maps.</i> • <i>License information/data is captured in the WARMS database. The PES/EIS information is not captured as there is no database to host this information.</i> • <i>Efforts should be synergized with the IUCMA. The Mpumalanga Provincial Office should leverage on the opportunities the IUCMA have to offer.</i> <u>North-West</u> • <i>There are issues around the overall allocation of groundwater and surface water in the catchment.</i> • <i>There are issues around over-allocation of water resources in stressed catchment areas. She further enquired how one would then deal with allocation in the stressed areas?</i> - <i>The RDM Team responded and provided the following measures for implementation: curtailments, water restrictions, and compulsory licensing.</i> • <i>There are cases of vandalism of hydrological gauging stations.</i> • <i>Water quality data not updated regularly on WMS;</i> • <i>The team should look at extraction of water quality data from the reports submitted as part of license applications; and</i> • <i>Shortage of personnel in relation to work that must be performed;</i> • <i>A concern was raised around the issue of the duration of the workshop session;</i> • <i>A consideration of the information presented to be translated into practical case studies;</i>

Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
	<i>The Reserve templates should be simplified for the case officers to make informed decision within a short period of time; and</i> <i>The 90 days turn around time for the license application does not allow the region sufficient time to submit the Record of Recommendations (RoR) to Head Office for specialist inputs on the Reserve.</i> <u>KZN</u> <i>The DWS restructuring process affected the Provincial Office and it is not clear how the RDM tools would be implemented.</i> <u>Eastern Cape</u> <i>There are gaps in terms of monitoring data which does not correlate with the associated Resource Units (RUs).</i> <i>There are no supporting Reserve/EWR Tables (Duration Curves) for the set WRC, Reserve and RQOs for the catchment.</i> <i>The RDM Team indicated that the Tables are available and would be shared with the Provincial Office in due course.</i> <i>There is confusion in terms whether Schedule 1 water use is considered for Basic Human Need (BHN) Reserve:</i> <i>The RDM Team responded that Schedule 1 water use and BHN should be treated separately.</i> <u>Northern Cape</u> <i>The representative explained the process and approaches they follow for RDM Interpretation. The process entails extraction of information received from the Water Use License application reports and a compilation of the RoR. If the Reserve is already set for the catchment in question, the case officer including the Water Use Authorization Assessment Advisory Committee (WUAAAC) interprets the information and make an informed decision on whether the license should be granted or declined; the decision is based on the set Reserve. In the absence of a Reserve, the case officer submits a request for specialist inputs to the Directorate: Reserve Determination at Head Office.</i>
AS 2.1	AS2.1-RP3 <i>KZN has not implemented RDM outputs yet.</i> <i>There are implementation challenges between CMA vs RO.</i> <i>There is a disconnect between the Regional Office and the Proto-CMA due to a misperception that everything needs to be implemented by the CMA. There are systems that operationally reside with the Regional office</i>

Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
	<i>main account such as the Hydrological/Geohydrological and River Health systems; it needs to be operationally made clear that regional office needs to conduct the work on these systems, and that they have a role to play.</i> • <i>Implementation requires integration between RO and CMA.</i>
AS 3.1	AS3.1-RP1 <i>RQO compliance monitoring initiative motivations:</i> • <i>RQO have been determined and gazetted for most Water Management Areas (WMAs) in the country.</i> • <i>But little has been done to implement and monitor compliance of the RQO.</i> • <i>Monitoring of compliance to the RQO will help improve the status of the country' water resources.</i> • <i>Enable the modification of programmes for resource management and impact control as and when necessary.</i> • <i>It will also assist in completion of the adaptive management cycle as indicated in process of determining RQO.</i> <i>Compliance monitoring to RQOs with the IUCMA, lessons learnt.</i> • <i>The IUCMA did a lot of work to understand and implement RQOs. This resulted in them communicating directly with the consultants who conducted the RDM project in their area.</i> - <i>This is incurring more costs as they are paying the consultants for RQO meetings and trainings.</i> • <i>Proposed solution – RDM to have the champions for each gazette to train and give support to regions and CMA when implementing.</i> • <i>Gazette variable (turbidity) with no numerical limit which makes it difficult to assess water quality compliance.</i> • <i>Gazette not specifying which toxins to monitor – IUCMA prioritized toxins according to the catchment specifics.</i> • <i>Alignment of monitoring points – some EWR points specified in the gazette are not in correlating directly with the monitoring points from the IUCMA – alignment of monitoring points had to be done.</i> - <i>But this had an impact on the compliance monitoring data analysis because some information will be from the previous point that is within the same river reach or in some cases not in the same river reaches.</i> - <i>Naming of regional monitoring points to change to EWR site points was tedious – needed working sessions to understand.</i>

Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
	• <i>Inaccessibility of monitoring points – accessible points had to be selected instead.</i> • <i>Sharing of knowledge makes the process easier.</i> - <i>Recommendation – to request the IUCMA officials to help the regions that are in need of information on implementing RQOs.</i> • <i>Gazette having priority RU points (EWR site points) and other tables having priority RU to be monitored by the CMA not for national reporting.</i> - <i>Inconsistencies in reporting especially the compliance status of the RQO.</i> - <i>Regions or CMAs reporting everything in the RQO while national office has been clarified to focus on the EWR site only.</i> AS3.1-RP3 <u>Researcher Question:</u> <i>What has been working well and how has the IUCMA done it?</i> • <i>The IUCMA has been conducting monitoring on the ground, both status monitoring and compliance monitoring; this has enabled identification of challenges and action to resolve them. Through this process they have now realised the need for reporting on it.</i> • <i>The IUCMA has received good feedback from stakeholders, there is Sanparks and Cross-border trans-boundary commitments - complying to RQOs also assists with complying to international obligations.</i> • <i>To successfully implement RDM, structures/units that are fully capacitated are needed in order to execute the work – the IUCMA has put in place fully functional units, each reporting on finding in all the different components.</i> <u>Challenges</u> • <i>The only thing that has been challenging is the licensing conditions vs RQOs that are not aligned:</i> • <i>Water Quality RQOs are less stringent than Water Use License (WUL) conditions – leading to users not complying with their license conditions arguing that they are still in compliance with the legal RQOs.</i> • <i>On the other hand:</i> - <i>Water Quantity RQOs at the 60th percentile have been too strict to adhere to given the MAR conditions in the catchment leading to adjustments made by the CMA to 70th percentile.</i>

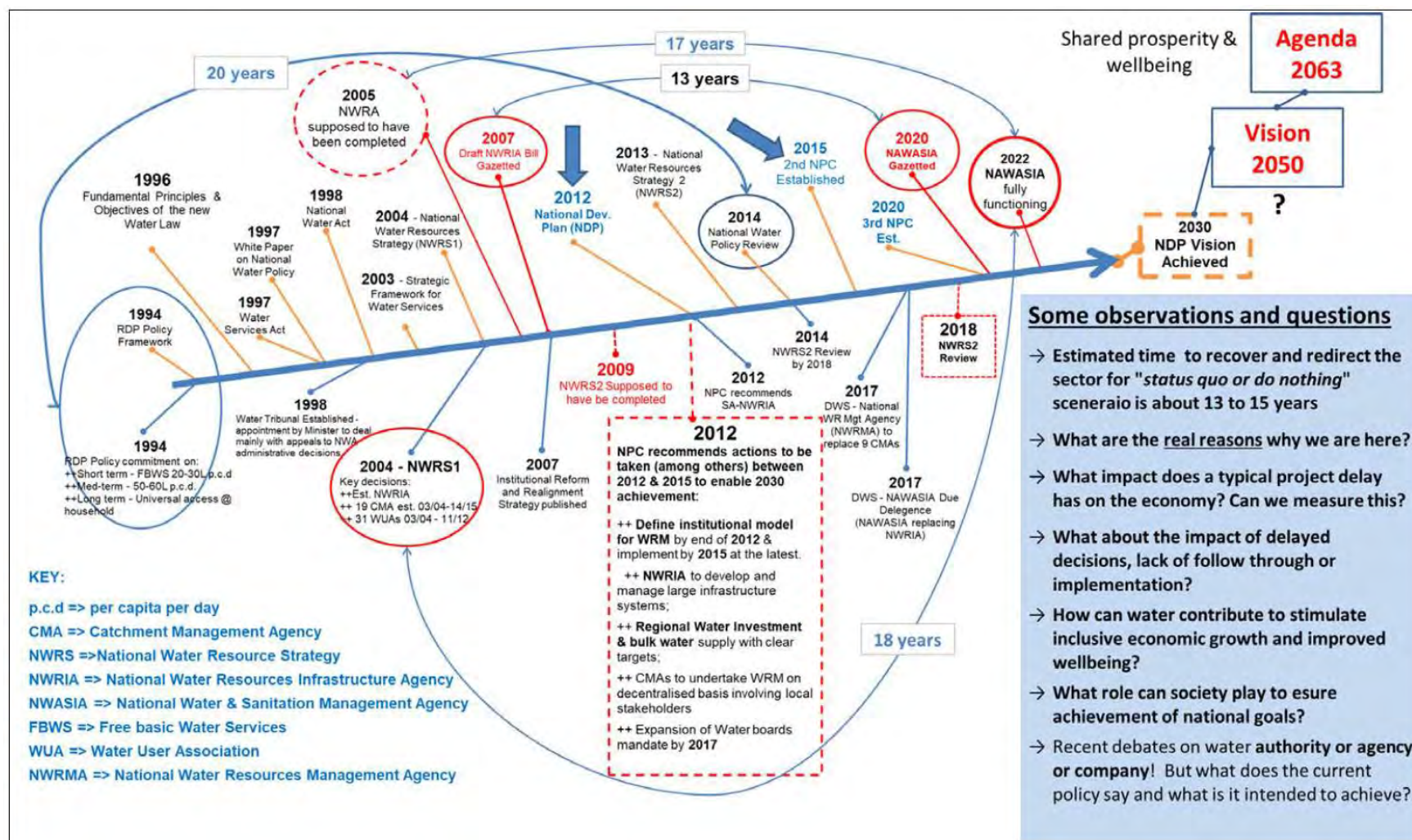
Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
AS 3.2	AS3.2-RP2 • <i>There is a big difference between implementation and monitoring. The two tend to be confused; where entities are conducting biomonitoring, it is not necessarily Reserve Implementation.</i> • <i>Implementation on the other hand involves both monitoring to identify the status and where unacceptable taking decisions to manage the resource. As an example, DWS has weirs in strategic areas within IUAs; in terms of flow, the weirs monitor for hydrology and resource managers evaluate the monitoring data in terms of the expected low flows or high flows. Where insufficient, water releases are implemented (i.e. operating rules where there is a Dam) or restrictions where it is due to over-abstraction.</i> • <i>In terms of WQ, indicative variables should be identified and managed.</i>
Interview Question: What are the challenges experienced with interpretation of RDM project outcomes for incorporation into license conditions?	
AS 2.1	• <i>AS2.1-RP3</i> • <i>Incorporation of RDM outputs / completed RDM studies in implementation tools</i> • <i>The relevant RDM outputs details need to be included in key implementation tools such as the DWS Recon studies. The details of RDM need to be clear in Recon documents and not only a high-level mention.</i> • <i>Municipalities do not incorporate them in their tools. IDPs are silent on RDM.</i> • <i>RDM Outputs misalignment</i> • <i>Some elements in the technical documents have been found to not match with the gazette details. In such cases the gazette information is used; however, this creates uncertainties as technical reports are meant to elaborate on the information one finds in the gazette.</i> • <i>Possible solution</i> • <i>The question is what should the outputs look like in implementation tools?</i> • <i>What are the outputs of RDM and how should they be implemented?</i> • <i>The practice implications of the outputs or a guideline into practice document is needed. These outputs would mean different things for different implementers; e.g. Monitoring programmes would consider different element, compared to an IDP.</i> • <i>A procedure is needed to determine how to utilise RDM outputs</i>
AS 3.1	AS3.1-RP2

Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
	• <i>There is a big wall between Head Office and Regional Offices - we don't behave as if we are one organisation – there is a segregation as though these are two different entities.</i> - <i>Each is defensive against the other.</i> - <i>As colleagues we must not undermine each other.</i> • <i>Similarly, cooperative management is not visible in the relations between Mpumalanga RO and IUCMA. In the duration of my working at the IUCMA, the interactions with the regional office were not evident.</i> AS3.1-RP3 • <i>Water Quality – the loads – limits have been set as part of license conditions. For WQ, when you check these loads in the license conditions versus the RQOs you find that the users are exceeding the RQO limits and each one will tell you that they are still within their license conditions. RQOs are more stringent than historically set limits. This challenge is created by a lack of process to review and update the current limits once RDM has not been conducted. A process for corrective measure needs to be undergone.</i> • <i>The RQOs are meant for the CMA to enforce and ensure that all the users in the system adhere to their conditions and collectively comply to the needs of the resource. RQOs are not meant to be complied with by any individual water user. The implementation actions that a CMA must undertake include:</i> - <i>Issuing licenses</i> - <i>Compliance monitoring</i> - <i>Monitoring the resources</i> <u>Quantity</u> • <i>Verification and Validation</i>
AS 3.2	AS3.2-RP1 • <i>In the Olifants Proto-CMA, there is no implementation of RDM outputs so far, although the gazette has been published for many years.</i> • <i>We only put a statement in the license conditions about RQOs which stakeholders and CMFs have indicated that they do not understand – upon request to the RQOs office for them to come and present and explain to stakeholders, we were told that stakeholder consultation meetings (public participation) were conducted in the area and the office can only prepare a presentation to provide to the regional office staff to present to the CMFs.</i>

Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
	- <i>I am a CME official, on the authorization side, I wouldn't be able to deliver such a presentation to the CMF.</i> AS3.2-RP2 • <i>Capacity challenges in terms of:</i> - <i>Expertise to understand the complexity of RDM, and</i> - <i>The necessary tools.</i>
Interview Question: What are the areas of disconnection between RDM determination and translation of outcomes into implementation programmes?	
AS 2.1	AS2.1-RP3 • <i>The practice implications of the outputs or a guideline into practice document is needed.</i> • <i>A practical guide needs to demonstrate how the RDM outputs should be translated into an implementation plan.</i> <u>Incorporation of RDM outputs / completed RDM studies in implementation tools:</u> • <i>The relevant RDM outputs details need to be included in key implementation tools such as the DWS Recon studies. The details of RDM need to be clear in Recon documents and not only a high-level mention.</i> • <i>Municipalities do not incorporate them in their tools. IDPs are silent on RDM.</i>
AS 3.1	AS3.1-RP2 • <i>IUCMA have found effective ways of translating RDM outputs into their implementation programmes. It is easier for them as managing a smaller organisation makes action easier.</i> AS3.1-RP3 • <i>Lack of a process for ensuring handover of RDM outputs to implementation officials on the ground.</i>
AS 3.2	AS3.2-RP1 • <i>We are not collaborating internally, among ourselves as DWS.</i> AS3.2-RP2 • <i>People think CMAs will be able to implement RDM and that is not so because they will just take over some functions of the Regional Offices/Proto-CMAs such as Regulation, Planning etc. The current institutional setup is not geared to deal with RDM and hence the resulting misalignment. The RDM function is currently not performed in the Regional Offices because it was seen as a centralised function at head office level. It will take time before the CMAs are fully functional and in some cases staff may need to be moved from Regional Offices, therefore people would need to be capacitated. As it currently stands, RDM is outsourced within DWS even at HO level, hence capacity to execute RDM</i>

Activity System	Local Implementation Role-Player Experiences on Implementation of RDM Outputs
	<i>is not available at all levels (HO and RO). Multi-expertise is needed at all levels and multiple tools.</i> • <i>Reserve implementation is currently happening incorrectly; and only the quantity component is being implemented from the point of view of operating rules (releases where there is a Dam or restrictions where there is over abstraction).</i> • <i>Monitoring vs Implementation of RDM are two different aspects.</i> • <i>Implementation requires assessment of the situation and putting management measures in place. This requires capacity (tools, expertise, funds). Capacity exists, but it lies elsewhere, with the DFFE within their Park Authorities and Conservation management divisions, however they also work within their boundary areas. Ironically the River does not conform to these boundaries.</i> • <i>Inter-relations between DFFE and DWS exist but we fail to see them. A Memorandum of Agreement (MoA) needs to be put in place or it must be captured in the legislation to enable action to happen for implementing RDM.</i>

APPENDIX 13: HISTORY OF DECISIONS POST DEVELOPMENT OF NEW WATER POLICY

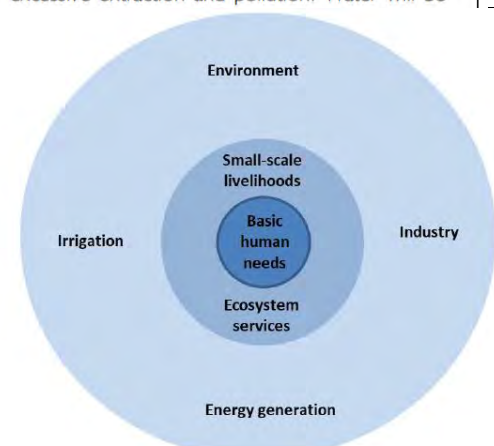


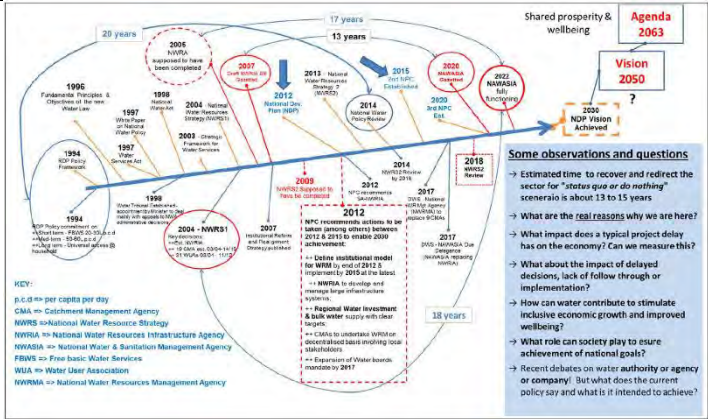
Source: Nepfumbada (2020)

APPENDIX 14: DOCUMENTS DATA SAMPLES (INCLUSION RATIONALE AND SNIPPETS)

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
1.	PD-A1-ConSA	Legislation	The Constitution of the Republic of South Africa	Republic of South Africa (Act 108 of 1996)	https://www.justice.gov.za/legislation/constitution/sac-constitution-web-eng.pdf 01/06/2021	Supreme law of South Africa detailing the Bill of Rights, including the protection of the environment through measures that prevent pollution and ecological degradation	Environment 24. Everyone has the right— (a) to an environment that is not harmful to their health or wellbeing; and (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that— (i) prevent pollution and ecological degradation; (ii) promote conservation; and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.
2.	PD-A2-NWA	Legislation	The National Water Act	Republic of South Africa (Act 36 of 1998)	https://www.dws.gov.za/RDM/WRC/SDoc/39943_22-4_NationalGovernment(1).pdf 31/05/2021	Key legislation document placing a legal obligation on all citizens to ensure that water resources are protected Chapter 7: Water Resource Management Institutional Roles and Responsibilities: RDM implementation at local level through DWS Regional Offices, CMAs and WUAs	CHAPTER 3 PROTECTION OF WATER RESOURCES <i>The protection of water resources is fundamentally related to their use, development, conservation, management and control. Parts 1, 2 and 3 of this Chapter lay down a series of measures which are together intended to ensure the comprehensive protection of all water resources. These measures are to be developed progressively within the contexts of the national water resource strategy and the catchment management strategies provided for in Chapter 2. Parts 4 and 5 deal with measures to prevent the pollution of water resources and measures to remedy the effects of pollution of water resources.</i> <i>Part 1: Classification system for water resources</i> <u>RDM Implementation takes place at Regional Level</u> NWA specifies the overarching goal of decentralising water resource management, through the Minister progressively establishing CMAs and WUAs. These institutions form the primary means of ensuring that local communities actively participate in water resource management. The Act recognises the “need for the integrated management of all aspects of water resources and, where appropriate, the delegation of management functions to a regional or catchment level so as to enable everyone to participate”

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
3.	PD-A3-NEMA	Legislation	The National Environmental Management Act (NEMA)	Republic of South Africa (Act 107 of 1998)	https://www.gov.za/sites/default/files/gcis_document/201409/a107-98.pdf 01/06/2021	Key legislation providing national environmental management principles	Chapter 1, Section 2 national environmental management principles: Act No. 107, 1998 NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ii) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; (iii) that the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied; (iv) that waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner; (v) that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource; (vi) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; (vii) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and (viii) that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether
4.	PD-WP1-White Paper	Policy	White Paper on a National Water Policy for South Africa	Republic of South Africa	05/07/2021	A key document that set the principles for the new government in South Africa post-apartheid on water	These activities and approaches are essential if we are to achieve the national goal of making sure that there will always be some water, for all who need it, contributing towards growing prosperity and equity in our land. This goal is captured in the slogan of the Department of Water Affairs and Forestry whose staff have committed themselves to ensuring: "Some, For All, For ever", which sums up the goals of: ¥ access to a limited resource (some) ¥ on an equitable basis (for all) ¥ in a sustainable manner, now and in the future (for ever).
5.	PD-NF1-NDP2030	Government Action Plan	National Development Plan (NDP) 2030	National Planning Commission (NPC), 2012	https://www.nationalplanningcommission.org.za/assets/Documents/ndp-2030-our-future-make-it-work.pdf 20/10/2021	Government's action plan for service delivery by 2030 to eliminate poverty and reduce inequality	Page 177: "Natural water resources will be protected to prevent excessive extraction and pollution. Water will be recognised as a foundation for activities such as tourism and recreation, reinforcing the importance of its protection".

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
							By 2030, it is envisaged that effective management of water and the services derived from it will support a strong economy and a healthy environment. The country's development will reflect an understanding of available water resources and effective water planning that cuts across different economic sectors and spheres of government. All main urban and industrial centres will have a reliable water supply to meet their needs, while increasingly efficient agricultural water use will support productive rural communities. Natural water sources will be protected to prevent excessive extraction and pollution. Water will be
6.	PD-NF2-NWSF	Institutional Document	NPC, – National Water Security Framework	Nepfumbada , 2020		Document echoes the key principles and priorities for the water sector, aligned to the NDP. Water ecosystem protection identified as a priority	 Figure 2. Important socio-economic water use requiring water security

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
							 Page 3: Nepfumbada, 2020 A key observation is that the water sector has not significantly transformed²³ as was envisaged when the policies were developed in the mid to late 1990s. Much of this could be attributed to the earlier emphasis on addressing the backlog of water and sanitation services provision to underserved communities during the Reconstruction and Development Programme (RDP), and subsequent weak implementation of key transformation programmes that thereby leaving the fundamental architecture of the old system largely intact. Challenges remain with the poor implementation of policy and legislation for a number of reasons, including an erosion of sector capacity, competence and leadership, and lack of collaboration and effective coordination among jointly responsible and implementing entities. This is exacerbated by the depletion of competence and capacity in the line-function Department, which has had adverse effect on its ability to provide effective sector leadership. The reactionary approach to change or amend policy that has not been implemented has further compounded the systemic problems. DME's 2015 Diagnostic report (in Nepfumbada, 2020) identified 6 key thematic areas that are seen as critical for water security and the below is 1 of them

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)		
							<table><tr><td>Human capital and institutional capacity.</td><td> • In each of the foregoing themes, deficient human capital and institutional capacity across the water value chain have surfaced among the key features that could inhibit water security • Skills shortage in the country has been at the centre of many discussions, and well documented • Although the skills deficit in the country is considered as critical, the problem is part of a global phenomenon affecting both developed and developing countries • Concerns about the capacity of key national government departments and municipalities - in ensuring the effective implementation of developmental water management and services </td></tr></table>	Human capital and institutional capacity.	• In each of the foregoing themes, deficient human capital and institutional capacity across the water value chain have surfaced among the key features that could inhibit water security • Skills shortage in the country has been at the centre of many discussions, and well documented • Although the skills deficit in the country is considered as critical, the problem is part of a global phenomenon affecting both developed and developing countries • Concerns about the capacity of key national government departments and municipalities - in ensuring the effective implementation of developmental water management and services
							Human capital and institutional capacity.	• In each of the foregoing themes, deficient human capital and institutional capacity across the water value chain have surfaced among the key features that could inhibit water security • Skills shortage in the country has been at the centre of many discussions, and well documented • Although the skills deficit in the country is considered as critical, the problem is part of a global phenomenon affecting both developed and developing countries • Concerns about the capacity of key national government departments and municipalities - in ensuring the effective implementation of developmental water management and services	
							<u>Challenges identified in Consultation Process of NWSF process: P48</u>		
<table><tr><th>ISSUE/AREA</th><th>COMMENTS/OBSERVATIONS</th></tr><tr><td>Governance and Institutional</td><td> • Institutional design may have had direct impact on effective decision making and implementation • Regulation/enforcement, monitoring and evaluation, enforcement of ground water use and capacity to manage water licensing conditions needs to be strengthened. • Investigate failure of CMAs implementation. Berg and Breede River systems are heavily involved in supplying the Western Cape Water Supply System and may be merged. </td></tr></table>	ISSUE/AREA	COMMENTS/OBSERVATIONS	Governance and Institutional	• Institutional design may have had direct impact on effective decision making and implementation • Regulation/enforcement, monitoring and evaluation, enforcement of ground water use and capacity to manage water licensing conditions needs to be strengthened. • Investigate failure of CMAs implementation. Berg and Breede River systems are heavily involved in supplying the Western Cape Water Supply System and may be merged.					
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NWSF, p131: <u>Water Sector Skills Challenge:</u>									

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
							A secure water future will not be achieved without addressing the issue of capacity – the skilled people required to undertake the work. A skills gap analysis conducted by the WRC in 2015, looking at numbers of staff and their skills relative to required skills, showed significant skills gaps in water sector institutions, including DWS, CMAs, water boards and municipalities. The Energy and Water Sector Education and Training Authority (EWSETA) is the skills development authority serving the water sector. However, it does not seem to be sufficiently assisting the challenges as they currently manifest. This is evident from the fact that a plethora of institutions has entered into the space of human capital development resulting in unnecessary duplication of effort at national level. It may be that another vehicle may need to be found where in the skills is located directly in the institutions of training and skills development such as TVETS, universities etc. to address the shortage of skills across the board. This may include closing down some of the “Academies” ran directly by line departments and their institutions so that their primary focus become on service delivery in line with their respective mandates. Further, the technical skills required for the line Department must be addressed urgently through attracting the right skills in the right proportions. The NWRs2 (see Figure 5 in the NWRs2) identified water sector skills as one of the key cross-cutting domain themes to enable efficient and effective management of water for equitable and sustainable growth and development; and dedicated a full chapter. This was located within the frame of integrated water resource management and provision of services generally across the sector. The importance of skills and capacity is further recognised in the NWSMP where it is identified that implementing it will require the right mix of skills and expertise in the water sector. This includes the capacity expressed as number of persons and skills expressed by qualification and experience required to fulfil the requirements in water resources and water services planning, management and operations. A critical need is to use the expertise of experienced water managers to mentor and develop younger and less experienced managers in the water P132, NWSF

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
							Box 9. Skills and capacity building Skills and capacity building A key challenge of the NWR52 is to increase our skills and capacity within the sector for both water resource management and water services. Institutions must be appropriately staffed and resourced and towards this end we will continue to prioritise skills development, staff motivation and capacity building at all levels. Increasing our regulatory capacity to improve compliance and ensure that standards and license conditions are met is an integral part of strengthening our institutional framework and capacity. NWR52, 2013 NWSF, P45: Key issues identified in the National Water Diagnostic Report, 2015 Human capital and institutional capacity. • In each of the foregoing themes, deficient human capital and institutional capacity across the water value chain have surfaced among the key features that could inhibit water security • Skills shortage in the country has been at the centre of many discussions, and well documented • Although the skills deficit in the country is considered as critical, the problem is part of a global phenomenon affecting both developed and developing countries • Concerns about the capacity of key national government departments and municipalities - in ensuring the effective implementation of developmental water management and services Challenges raised during NWSF consultation include: Human capital and institutional capacity. • Re-professionalise engineering, scientific and technical fields. • Deal with revolving door • Ongoing failure to address skills shortage and asymmetry is the single biggest strategic risk facing water management in South Africa
7.	PD-Reg1-810	Legislation	Government Gazette_Regulations 810	Department of Water Affairs (DWA) (2010), Government Gazette 33541	https://www.dws.gov.za/RDM/WRC/S/default.aspx 31/05/2021	Key Policy providing formal direction on how RDM should be conducted – WRC 7 step C Figure 1: Outline of and relationship between the	Regulations providing procedures for the determination of Water Resource Classes and RQOs, screenshot examples:

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
						Water Resource Classification System (WRCS) and the ecological Reserve determination procedure (adapted from Dollar et al., 2007; Louw and Hughes, 2002). Each step of the Reserve determination procedure is represented by its own colour. Shading of these colours under the WRCS indicates some overlap between steps of the WRCS and where they occur in the Reserve determination.	(4) The procedure to determine the different classes of water resources must comprise of the following 7 steps: (a) Step 1: Delineate the units of analysis and describe the status quo of the water resource or water resources; (b) Step 2: Link the socio-economic and ecological value and condition of the water resource or water resources; (c) Step 3: Quantify the ecological water requirements and changes in non-water quality ecosystem goods, services and attributes; (d) Step 4: Determine an ecologically sustainable base configuration scenario; (e) Step 5: Evaluate scenarios within the integrated water resource management process; (f) Step 6: Evaluate the scenarios with stakeholders; and (g) Step 7: Gazette and implement the class configuration. Procedure for determining resource quality objectives 4. For each water resource class, the procedure for establishing resource quality objectives must comprise of the following 6 steps: (a) Step 1: Identify water users within each water resource management unit, and where appropriate, align with Step 1 of the water resource classification procedure set out in regulation 2(4); (b) Step 2: Determine the present state per water user and, where appropriate, align with Step 5 of the water resource classification procedure set out in regulation 2(4); (c) Step 3: Determine the desired water quality per user and, where appropriate, align with Step 6 of the water resource classification procedure set out in regulation 2(4); (d) Step 4: Determine water user specifications and, where appropriate, align with Step 6 of the water resource classification procedure set out in regulation 2(4); (e) Step 5: Determine water quality requirements of water uses and, where appropriate, align with Step 6 of the water resource classification procedure set out in regulation 2(4); and (f) Step 6: Gazette and implement the resource quality objectives.

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
							Water Resource Classification System Step 1: Delineate the integrated units of analysis and describe the status quo of the water resources - define significant water resources - Establish nodes - Delineate socio-economic zones and describe use of aquatic ecosystems Step 2: Link the value and condition of the water resource - select EGSAs to be considered Step 3: Quantify the Ecological Water Requirements (EWRs) and changes in non-water quality Ecosystem Goods, Services and Attributes (EGSAs) Step 4: Determine an ESBC scenario and establish starter configuration scenarios Step 5: Evaluate the scenarios within the Integrated Water Resource Management (IWRM) process Step 6: Evaluate the scenarios with stakeholders Step 7: Gazette the class configuration Ecological Reserve Determination Procedure 1: Initiate RDM study - define study area - select RDM level and components - establish study team 1.1 Project scope 1.2 RESERVE COMPONENTS (rivers, ground-water, estuaries, wetlands) 1.3 RDM Protocols 1.4 Cost/benefit analysis 1.5. RDM LEVEL (Rapid I, II, III, Intermediate, Comprehensive) 2: Define Resource Units 2.1 Ecoregions 2.2 Geomorphological zonation 2.3 System operation 2.4 Select IFR/EWR sites 3: Define ecological Reserve categories and recommend 3.1 ECOLOGICAL RESERVE CATEGORISATION - Reference condition, present ecological status, trajectories of change, ecological importance, and sensitivity, socio/cultural importance, constraints 3.2 STAKEHOLDER PROCESS - capacity building, empowering 4: Quantify ecological Reserve scenarios 4.1 DATA ORGANISATION - collate existing data, collect additional info, analyse info 4.2 IFR/EWR SPECIALIST MEETING follow process: BDM, Stressor Response, DRIFT 5: Ecological consequences of operational scenarios (quantity and quality) Yield consequences of the Reserve 5.1 Catchment system analysis 5.2 Integration (BDM and Reserve components) 5.3 Yield & stakeholder requirements, operational constraints 5.4 Define operational scenarios 5.5 Provide resource economic consequences 5.6 Stakeholder process (scenario implications & assessment) 6: DWAF management class decision-making process 6.1 Information on categories other than ecological i.e. domestic use, irrigation, recreation etc. 7: Reserve definition 7.1 Resource quality objectives (RQO) 7.2 Monitoring protocols (baseline, refining and compliance) 7.3 Implementation, operating rules and methods 8: Implementation Plan
8.	PD-GG1-39943	Government Gazette	RDM Classes & RQOs Gazettes: Olifants-Doorn, Vaal (Upper, Middle and Lower), Olifants WMAs	Republic of South Africa	https://www.dws.gov.za/RDM/WRC/S/default.aspx 31/05/2021	Government Gazettes for ensuring RDM provisions are observed in the Olifants-Doorn, Olifants and Vaal WMAs where determinations have been made	600 No. 39943 GOVERNMENT GAZETTE, 22 APRIL 2016 DEPARTMENT OF WATER AND SANITATION NO. 467 22 APRIL 2016 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) CLASSES AND RESOURCE QUALITY OBJECTIVES OF WATER RESOURCES FOR THE OLIFANTS-DOORN CATCHMENTS 546 No. 39943 GOVERNMENT GAZETTE, 22 APRIL 2016 DEPARTMENT OF WATER AND SANITATION NO. 466 22 APRIL 2016 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) CLASSES AND RESOURCE QUALITY OBJECTIVES OF WATER RESOURCES FOR THE OLIFANTS CATCHMENT

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
							618 No. 39943 GOVERNMENT GAZETTE, 22 APRIL 2016 DEPARTMENT OF WATER AND SANITATION NO. 468 22 APRIL 2016 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) CLASSES AND RESOURCE QUALITY OBJECTIVES OF WATER RESOURCES FOR CATCHMENTS OF THE UPPER VAAL STAATSKOERANT, 22 APRIL 2016 No. 39943 653 DEPARTMENT OF WATER AND SANITATION NO. 469 22 APRIL 2016 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) CLASSES AND RESOURCE QUALITY OBJECTIVES OF WATER RESOURCES FOR CATCHMENTS OF THE MIDDLE VAAL STAATSKOERANT, 22 APRIL 2016 No. 39943 721 DEPARTMENT OF WATER AND SANITATION NO. 470 22 APRIL 2016 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) CLASSES AND RESOURCE QUALITY OBJECTIVES OF WATER RESOURCES FOR CATCHMENTS OF THE LOWER VAAL 546 No. 39943 GOVERNMENT GAZETTE, 22 APRIL 2016 DEPARTMENT OF WATER AND SANITATION NO. 466 22 APRIL 2016 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) CLASSES AND RESOURCE QUALITY OBJECTIVES OF WATER RESOURCES FOR THE OLIFANTS CATCHMENT

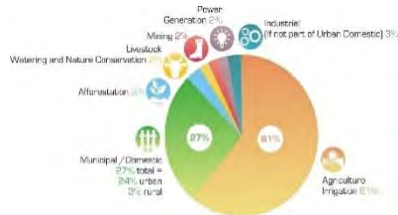
No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)			
9.	PD-GG2-40531	Government Gazette	RDM Classes & RQOs Gazettes: Inkomati and Letaba WMAs	Republic of South Africa	https://www.dws.gov.za/RDM/WRC/S/default.aspx 31/05/2021	Government Gazettes for ensuring RDM provisions are observed in WMAs where determinations have been made Both gazettes were also published in the local languages (isiSwati and Sepedi)	4 No. 40531 GOVERNMENT GAZETTE, 30 DECEMBER 2016 GOVERNMENT NOTICES • GOEWERMENTSKENNISGEWINGS DEPARTMENT OF WATER AND SANITATION NO. 161630 DECEMBER 2016 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) CLASSES OF WATER RESOURCES AND RESOURCE QUALITY OBJECTIVES FOR THE CATCHMENTS OF THE INKOMATI 80 No. 40531 GOVERNMENT GAZETTE, 30 DECEMBER 2016 DEPARTMENT OF WATER AND SANITATION NO. 161730 DECEMBER 2016 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) CLASSES OF WATER RESOURCES AND RESOURCE QUALITY OBJECTIVES FOR THE LETABA CATCHMENT			
10.	PD-GG3-41306	Government Gazette	RDM Classes & RQOs Gazettes: Mvoti-Umzimkulu	Republic of South Africa	https://www.dws.gov.za/RDM/WRC/S/default.aspx 31/05/2021	Government Gazettes for ensuring RDM provisions are observed in WMAs where determinations have been made	214 No. 41306 GOVERNMENT GAZETTE, 8 DECEMBER 2017 DEPARTMENT OF WATER AND SANITATION NO. 138608 DECEMBER 2017 NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) CLASSES OF WATER RESOURCES AND RESOURCE QUALITY OBJECTIVES FOR THE CATCHMENTS OF THE MVOTI TO UMZIMKULU			
11.	PD-GG4-42775	Government Gazette	RDM Classes & RQOs Gazette: Mokolo, Matlabas, CrocWest and Marico	Republic of South Africa	https://www.dws.gov.za/RDM/WRC/S/default.aspx 31/05/2021	Government Gazettes for ensuring RDM provisions are observed in WMAs where determinations have been made	STAATSKOERANT, 18 OKTOBER 2019 No. 42775 103 DEPARTMENT OF WATER AND SANITATION NOTICE 562 OF 2019 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) DETERMINATION OF WATER RESOURCE CLASSES AND RESOURCE QUALITY OBJECTIVES FOR MOKOLO, MATLABAS, CROCODILE (WEST) AND MARICO CATCHMENTS			
12.	PD-GG5-43015	Government Gazette	RDM Classes & RQOs Gazette: Mzimvubu	Republic of South Africa	https://www.dws.gov.za/RDM/WRC/S/default.aspx 31/05/2021	Government Gazettes for ensuring RDM provisions are observed in WMAs where determinations have been made	<table><tr><td>Mzimvubu</td><td>The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.</td><td>GG 43015 of 14 February 2020.</td></tr></table>	Mzimvubu	The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.	GG 43015 of 14 February 2020.
Mzimvubu	The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.	GG 43015 of 14 February 2020.								

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
13.	PD-GG6-43726	Government Gazette	Classes & RQOs Gazette: Breede-Gouritz	Republic of South Africa	https://www.dws.gov.za/RDM/WRC/S/default.aspx 31/05/2021	Government Gazettes for ensuring RDM provisions are observed in WMAs where determinations have been made Both gazettes were also published in the local language (Afrikaans)	STAATSKOERANT, 18 SEPTEMBER 2020 No. 43726 81 DEPARTMENT OF WATER AND SANITATION NO. 1008 18 SEPTEMBER 2020 NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) DETERMINATION OF CLASSES OF WATER RESOURCES AND RESOURCE QUALITY OBJECTIVES FOR THE BREEDE-GOURITZ WATER MANAGEMENT AREA
14.	PD-GG7-42457	Government Gazette	RDM Classes & RQOs Gazette: Berg	Republic of South Africa	https://www.dws.gov.za/RDM/WRC/S/default.aspx 31/05/2021	Government Gazettes for ensuring RDM provisions are observed in WMAs where determinations have been made	STAATSKOERANT, 6 NOVEMBER 2020 No. 43872 67 DEPARTMENT OF WATER AND SANITATION NO. 1179 06 NOVEMBER 2020 NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) DETERMINATION OF CLASSES OF WATER RESOURCE AND ASSOCIATED RESOURCE QUALITY OBJECTIVES FOR THE BERG CATCHMENT I, Lindiwe Sisulu, Minister of Human Settlements, Water and Sanitation hereby in terms of section 13(1) of the National Water Act, 1998 (Act No. 36 of 1998) determine the classes of water resources and associated resource quality objectives, as set out in the Schedule.

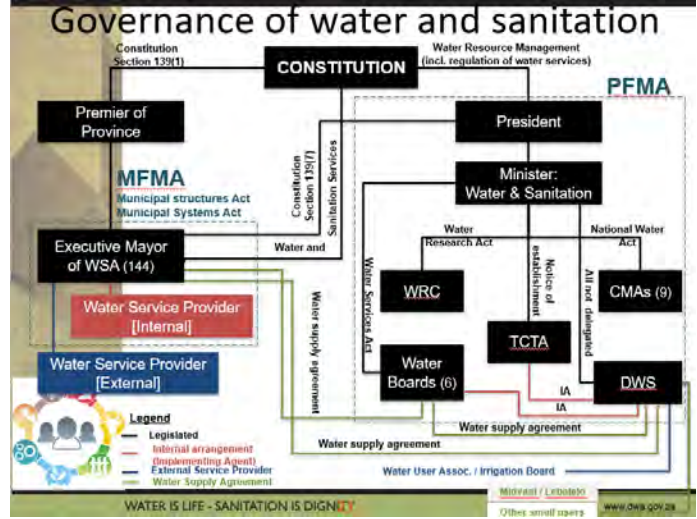
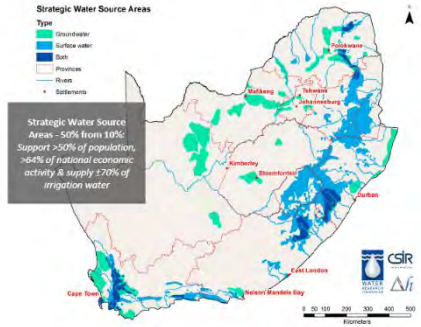
No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
15.	PD-GG8-41473	Government Gazette	RDM Reserve – Olifants Doorn	Republic of South Africa	https://www.dws.gov.za/wem/currentstudies/gazettedreserves.aspx 2024	Gazetted Reserve	310 No. 41473 GOVERNMENT GAZETTE, 2 MARCH 2018 DEPARTMENT OF WATER AND SANITATION NO. 189 02 MARCH 2018 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) RESERVE DETERMINATION OF WATER RESOURCES FOR THE OLIFANTS-DOORN CATCHMENTS I, Sifiso Mkhize, in my capacity as the Acting Director-General of the Department of Water and Sanitation, having complied with section 13 of the National Water Act, (Act No. 36 of 1998) ("the Act") and Regulation 3 of the Regulations for the establishment of Water Resource Classification System (No. R. 810 Government Gazette No. 33541, 17 September 2010), and duly authorised in terms of sections 16(1) and 63(1)(a) of the Act, after having complied with section 16(2) and (3) of the Act, hereby publish the Reserve Determination of water resources for the Olifants-Doorn catchments.
16.	PD-GG9-41887	Government Gazette	RDM Reserve - Olifants and Letaba	Republic of South Africa	https://www.dws.gov.za/wem/currentstudies/gazettedreserves.aspx 2024	Gazetted Reserve	STAATSKOERANT, 7 SEPTEMBER 2018 No. 41887 125 DEPARTMENT OF WATER AND SANITATION NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) RESERVE DETERMINATION OF WATER RESOURCES FOR THE OLIFANTS AND LETABA CATCHMENTS I, Deborah Mochotlhi, in my capacity as the Acting Director-General of the Department of Water and Sanitation, having complied with section 13 of the National Water Act, (Act No. 36 of 1998) ("the Act") and Regulation 3 of the Regulations for the establishment of Water Resource Classification System (No. R. 810 Government Gazette No. 33541, 17 September 2010), and duly authorised in terms of sections 16(1) and 63(1)(a) of the Act, after having complied with section 16(2) and (3) of the Act, hereby publish the Reserve determination of water resources for the catchments of the Olifants and Letaba.

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
17.	PD-GG10-41970	Government Gazette	RDM Reserve - Mvoti	Republic of South Africa	https://www.dws.gov.za/wem/currentstudies/gazettedreserves.aspx 2024	Gazetted Reserve	102 No. 41970 GOVERNMENT GAZETTE, 12 OCTOBER 2018 DEPARTMENT OF WATER AND SANITATION NO. 1097 12 OCTOBER 2018 NATIONAL WATER ACT, 1998 (ACT NO.36 OF 1998) RESERVE DETERMINATION OF WATER RESOURCES FOR THE MVOTI TO UMZIMKULU CATCHMENTS I, Deborah Mochotlhi, in my capacity as the Acting Director-General of the Department of Water and Sanitation, having complied with section 13 of the National Water Act, (Act No. 36 of 1998) ("the Act") and Regulation 3 of the Regulations for the establishment of Water Resource Classification System (No. R. 810 Government Gazette No. 33541, 17 September 2010), and duly authorised in terms of sections 16(1) and 63(1)(a) of the Act, after having complied with section 16(2) and (3) of the Act, hereby publish the Reserve determination of water resources for the catchments of the Mvoti to Umzimkhulu Catchments.
18.	PD-GG11-42584	Government Gazette	RDM Reserve - Inkomati	Republic of South Africa	https://www.dws.gov.za/wem/currentstudies/gazettedreserves.aspx 2024	Gazetted Reserve	92 No. 42584 GOVERNMENT GAZETTE, 19 JULY 2019 DEPARTMENT OF WATER AND SANITATION NO. 998 19 JULY 2019 NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) RESERVE DETERMINATION OF WATER RESOURCES FOR THE INKOMATI CATCHMENT I, Gugile Ernest Nkwintli, in my capacity as Minister of Water and Sanitation of the Department of Water and Sanitation, having complied with section 13 of the National Water Act, (Act No. 36 of 1998) ("the Act") and Regulation 3 of the Regulations for the establishment of Water Resource Classification System (No. R. 810 Government Gazette No. 33541, 17 September 2010), and duly authorised in terms of sections 16(1) and 63(1)(a) of the Act, after having complied with section 16(2) and (3) of the Act, hereby publish the Reserve determination of water resources for the Inkomati catchment.

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
19.	PD-GG12-43734	Government Gazette	RDM Reserve - Vaal	Republic of South Africa	https://www.dws.gov.za/wem/currentstudies/gazettedreserves.aspx 2024	Gazetted Reserve	STAATSKOERANT, 25 SEPTEMBER 2020 No. 43734 25 DEPARTMENT OF WATER AND SANITATION NO. 1019 25 SEPTEMBER 2020 NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) RESERVE DETERMINATION FOR THE WATER RESOURCES OF THE VAAL WATER MANAGEMENT AREA I, Lindiwe Sisulu, Minister of Human Settlements, Water and Sanitation, in terms of section 16(1) of the National Water Act, 1998 (Act No. 36 of 1998), hereby determine the Reserve for the water resources in the the Vaal Water Management Area, as set out in the Schedule. STAATSKOERANT, 3 DESEMBER 2021 No. 45568 123 DEPARTMENT OF WATER AND SANITATION NO. 1559 3 December 2021 NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) RESERVE DETERMINATION FOR WATER RESOURCES OF THE CROCODILE WEST AND MARICO CATCHMENTS IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) I Senzo Mchunu, in my capacity as Minister of Water and Sanitation, having complied with section 13 of the National Water Act, 1998 (Act No. 36 of 1998) ("the Act"), and Regulation 3 of the Regulations for the Establishment of Water Resource Classification System (No. R. 810 <i>Gazette</i> No. 33541, 17 September 2010), and duly authorised in terms of sections 16(1) and 63(1)(a) of the Act, after having complied with section 16(2) and (3) of the Act, hereby publish the Reserve determination for water resources of the Crocodile West and Marico catchments.
20.	PD-GG13-45568	Government Gazette	RDM Reserve – Croc-West	Republic of South Africa	https://www.dws.gov.za/wem/currentstudies/gazettedreserves.aspx 2024	Gazetted Reserve	STAATSKOERANT, 3 DESEMBER 2021 No. 45568 123 DEPARTMENT OF WATER AND SANITATION NO. 1559 3 December 2021 NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) RESERVE DETERMINATION FOR WATER RESOURCES OF THE CROCODILE WEST AND MARICO CATCHMENTS IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) I Senzo Mchunu, in my capacity as Minister of Water and Sanitation, having complied with section 13 of the National Water Act, 1998 (Act No. 36 of 1998) ("the Act"), and Regulation 3 of the Regulations for the Establishment of Water Resource Classification System (No. R. 810 <i>Gazette</i> No. 33541, 17 September 2010), and duly authorised in terms of sections 16(1) and 63(1)(a) of the Act, after having complied with section 16(2) and (3) of the Act, hereby publish the Reserve determination for water resources of the Crocodile West and Marico catchments.

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
21.	PD-GG14-45735	Government Gazette	RDM Reserve – Mokolo and Matlabas	Republic of South Africa	https://www.dw.s.gov.za/wem/currentstudies/gazettedreserves.aspx 2024	Gazetted Reserve	16 No. 45735 GOVERNMENT GAZETTE, 14 JANUARY 2022 DEPARTMENT OF WATER AND SANITATION NO. 1669 14 January 2022 NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) RESERVE DETERMINATION FOR WATER RESOURCES OF THE MOKOLO AND MATLABAS CATCHMENTS I, Senzo Mchunu, in my capacity as Minister of Water and Sanitation, and duly authorised in terms of sections 18(1) of the National Water Act, 1998 (Act No. 36 of 1998), hereby publish the Reserve determination for water resources of the Mokolo and Matlabas catchments.
22.	ID-SP1-NW&SMP	Institutional Document – Sector Plan	DWS, National Water and Sanitation Master Plan	Department of Water and Sanitation, 2018	http://www.dwa.gov.za/National%20Water%20and%20Sanitation%20Master%20Plan/default.aspx 18/03/2021	Key DWS document detailing pressures leading to degradation of water ecosystems include increasing population, rapid urban expansion, mining, poor agricultural practices, mining Document detailing the challenges water resource management and proposed actions	Page 10: Current water use per sector  How we use our water resources in South Africa

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
						Challenge of aquatic ecosystem degradation and highlighting findings from Nel and Driver (2015) on deterioration of the ecological condition of South African Rivers Key sector partnerships in the Master Plan document: <i>The South African Biodiversity Institute (SANBI), DWS and the Council for Scientific and Industrial Research (CSIR) have identified key strategic water source areas in the country which must be protected and maintained if water security is to be achieved. The Department of Environmental Affairs (DEA) and SANBI have received funding from the Global Environment Facility (GEF) for improving financial flows for restoring ecological infrastructure and for strengthening</i>	Many of our high value aquatic ecological infrastructure assets are poorly protected, and in some areas of the country they are under severe pressure, for example from intensive agriculture, mining and urban sprawl that results in loss or degradation of ecosystems. Like built infrastructure, ecological infrastructure needs to be maintained, and in some cases restored, in order for its socio-economic benefits to be realised. <i>Between 1999 and 2011 river health deteriorated across all South Africa's nine water management areas. The extent of main rivers in South Africa with a poor ecological condition increased by 500% between 1999-2011 with many rivers pushed beyond the point of recovery. The extent of tributaries with a poor ecological condition increased by 229% in this same period (see Figure 9). Healthy tributaries often play a critical role in maintaining flow and water quality in hard-working main rivers.</i> <i>It is estimated that South Africa has lost over 50% of its wetlands, and of the remaining 3.2 million ha (less than 5% of SA's land cover) a third are already in a poor condition (see Figure 10), limiting their ability to, for example, regulate water flow and purify water.</i> Figure 9: Deterioration of ecological condition of South African rivers, 1999 – 2011 (Source: Nel, J.L. & Driver, A. 2015. National River Ecosystem Accounts for South Africa) There are several challenges associated with the current institutional arrangements that need to be addressed to create appropriate and effective institutions with clear mandates, not least the overly complex value chain of institutions currently in place. DWS is policy maker, regulator, implementer and operator of water resource infrastructure and acts as CMAs in most of the country. Some of these roles have potential conflicts of interest, while, water resources regulation, which is local in nature, could be performed better by more decentralised institutions.

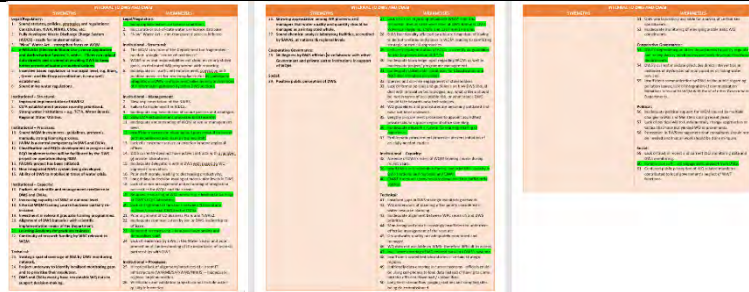
No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
						<i>institutional capacity for this task</i> “The institutional landscape of the water sector is also overly complex and not sufficiently transformed, which is impacting the value chain” Water sector institutional arrangement and responsibilities = various institution involved in the management of water in SA; hence water resource protection is also a responsibility that spans across several institutions	Governance of water and sanitation  Key partnership initiatives by institution with a shared water resource protection mandate enabling strategic water source areas protection Page 39: ID2_NWSMP  Figure 11: Strategic water source areas: the 10% of South Africa's land that delivers 50% of our water

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
23.	ID-SS1-NWRS-Ed1	Sector Strategy, NWRS Edition 1	National Water Resource Strategy (NWRS, 2004)	Department of Water and Forestry (DWAf)	https://cer.org.za/wp-content/uploads/2017/10/NWRS-2004.pdf Centre for environmental rights (CER) 20/10/2021	Key Strategy Document with a dedicated section on the need for development of RDM for protection of water resources by setting objectives for the desired condition of resource	To give effect to the interrelated objectives of sustainability and equity an approach to managing water resources has been adopted that introduces measures to protect water resources by setting objectives for the desired condition of resources, and putting measures in place to control water use to limit impacts to acceptable levels. The approach comprises two complementary strategies as follows - - Resource-Directed Measures: These measures focus on the quality of the water resource itself. Resource quality reflects the overall health or condition of the water resource, and is a measure of its ecological status. Resource quality includes water quantity and water quality, the character and condition of in-stream and riparian habitats, and the characteristics, condition and distribution of the aquatic biota. Resource quality objectives will be defined for each significant resource to describe its quality at the desired level of protection. (See Note 3 in Chapter 1 and Part 2 of this chapter for the definition of water use). - Source-Directed Controls: These measures contribute to defining the limits and constraints that must be imposed on the use of water resources to achieve the desired level of protection. They are primarily designed to control water use activities at the source of impact, through tools such as standards and the situation-specific conditions that are included in water use authorisations. Source-directed controls are the essential link between the protection of water resources and the regulation of their use. (Conditions of use are discussed in Part 2 of this chapter). Coherent and integrated approaches to balancing the protection and use of water resources will therefore require the collective application of resource-directed measures and source-directed controls in respect of water quantity and quality, as well as the biological and physical dimensions of the resource. Although the Act promotes, among other things, resource protection to support long-term sustainable use and development, water resources are sometimes polluted or damaged through accident, negligence or deliberate actions. In such cases the Act holds the parties responsible for the pollution or damage liable for any clean-up or rehabilitation that may be necessary.
24.	ID-SS2-NWRS-Ed2	Sector Strategy, NWRS Edition 2	DWA NWRS2	Department of Water Affairs, 2013	https://cer.org.za/wp-content/uploads/2013/07/NWRS2-Final-email-version.pdf 20/10/2021	Key Strategy Document outlining objectives of the Department – responds to priorities set in the NDP To compare the provisions for water ecosystems management to NWRS1 and achievements made to date since NWRS 1 Executive Summary:	The key principles to enable water resource protection are founded on ensuring that sufficient water is left in the rivers to sustain ecosystem functioning, that the quality of the resource is protected at the source and that the water environment has an intrinsic value for economic and social growth.  Principle 1: Protection of the resource through classification of the resource with the Reserve as a prior right. The most critical resource protection imperative over the next five years is the use of the gazetted classification process to classify all the major rivers, wetlands and aquifers. This should involve stakeholder engagement to create ownership of the water resources. The amount of water available to allocate will be determined after accounting for the Reserve, the international obligations and the water requirements for power generation, which is considered a strategic sector.  Principle 2: Water resource protection should be based on a participatory approach, involving users, planners and policymakers at all levels. The participatory approach to water resource protection should involve raising awareness of the importance and value of water among policymakers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the management of our water resources.  Principle 3: The value of water resources must be recognised from an economic point of view and the social and environmental benefits of the resource. It is important that society recognises determining the economic value of water, accounting for the use of water (for example, household water supply and irrigation for agriculture) and the ecosystem services provided or supported by water resources (for example, nutrient cycling, habitat provision, and recreation).  Principle 4: Water resource protection must guide setting conditions for water-use authorisation. Water resource protection is effected through Resource Directed Measures (RDM), which set the goals for optimising the allocative efficiency of the water resource among its competing demands, and Source Directed Controls (SDC), which set abstraction 5.3 Objectives The key strategic objectives for water resource protection are: • Ensure sustainable management of the water resources through resource directed measures and source-directed controls. • Protect and maintain existing freshwater ecosystem priority areas in good condition and self-functioning water resource ecosystems, by managing riparian and wetland buffers and critical groundwater recharge areas. • Carry out rehabilitation of strategic water ecosystems. • Ensure prevention of water resources from point source and non-point source pollution by managing at source. • Create awareness among communities, business and decision makers about the value of water and ensure commitment to sustainable water use practices. • Create an enabling environment for water resource protection through incentive based approach to water resources management. • Monitor the ecological health of our resources through an integrated information management system. 5.4 Strategic actions 5.4.1 Manage for sustainability using resource directed measures A management class, and associated Reserve and resource quality objectives (RQO) have been set and approved for every significant water resource in the country. Resource quality objectives are regularly monitored for compliance, which informs enforcement and a strategic adaptive management cycle.

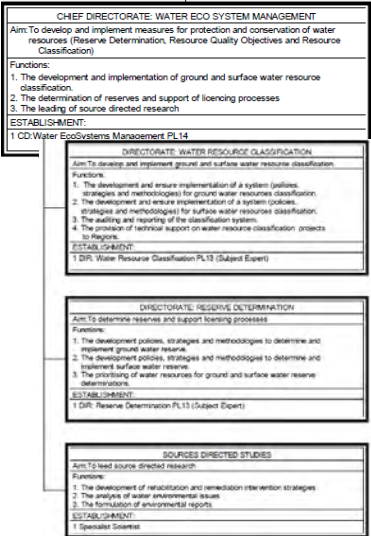
No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
						The NWRS2 builds on the first NWRS published in 2004. The purpose of the NWRS2 is to ensure that national water resources are protected, used, developed, conserved, managed and controlled in an efficient and sustainable manner towards achieving South Africa's development priorities in an equitable manner over the next five to 10 years. This Strategy responds to priorities set by Government within the National Development Plan (NDP) and National Water Act imperatives that support sustainable development.	The decision on the consolidation of the 19 WMAs into 9 new WMAs has also only recently been confirmed. Consequently, it was decided not to update the national and WMA water balance tables in the format produced in NWRS1 for this version of the NWRS, but rather to focus the limited available skills and resources on developing detailed water resource Reconciliation Strategies that are directed at meeting specific demands as a basis for water management and infrastructure planning.  Figure 1: The previous and consolidated water management areas (Source: NWRS2)

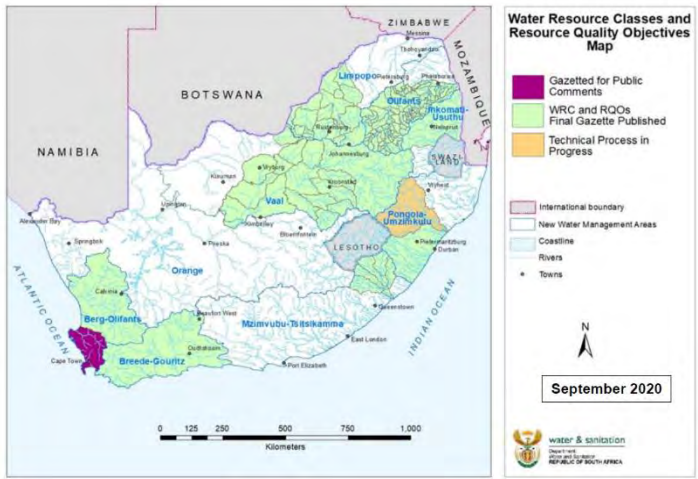
No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)				
							NWRS 2: Page 2 Table 1 highlights successes and weaknesses in the implementation of the NWRS1. The summaries of the Reconciliation Strategies, contained in Annexure A of this document, present additional information on the progress made in the implementation of the NWRS1 since 2004. <table><tr><th>Achievements</th><th>Outstanding Challenges</th></tr><tr><td> • Development of new water resources and water supply infrastructure and an investment in improved dam safety for state dams • Water Reconciliation Strategies in major urban areas and improved insights into reliable future water demands and supplies • A significant proportion of Reserve determinations have been done with different level of confidence • Incentive-based regulation through Blue and Green Drop assessments • Improved sector collaboration and participation • A Learning Academy to improve skills and capacity within the sector • Two Catchment Management Agencies established • Support given to numerous resource-poor farmers • Water sharing agreements and institutional arrangements in place in all trans-boundary basins </td><td> • Achievement of water conservation and water demand management targets • Streamlined water allocation reform to redress past racial and gender imbalances in access to water for productive uses and to address poverty and inequality • Implementation of environmental flow monitoring • Establishment of water management institutions and the decentralisation of water resources management • Strengthening of regulation of water resources and water quality • Improvement of technical and management skills to implement developmental water resource management • Improvement in the integration of monitoring and information management • Reduction in the backlog of infrastructure maintenance </td></tr></table> Table 1: Implementation analysis of the NWRS1	Achievements	Outstanding Challenges	• Development of new water resources and water supply infrastructure and an investment in improved dam safety for state dams • Water Reconciliation Strategies in major urban areas and improved insights into reliable future water demands and supplies • A significant proportion of Reserve determinations have been done with different level of confidence • Incentive-based regulation through Blue and Green Drop assessments • Improved sector collaboration and participation • A Learning Academy to improve skills and capacity within the sector • Two Catchment Management Agencies established • Support given to numerous resource-poor farmers • Water sharing agreements and institutional arrangements in place in all trans-boundary basins	• Achievement of water conservation and water demand management targets • Streamlined water allocation reform to redress past racial and gender imbalances in access to water for productive uses and to address poverty and inequality • Implementation of environmental flow monitoring • Establishment of water management institutions and the decentralisation of water resources management • Strengthening of regulation of water resources and water quality • Improvement of technical and management skills to implement developmental water resource management • Improvement in the integration of monitoring and information management • Reduction in the backlog of infrastructure maintenance
Achievements	Outstanding Challenges										
• Development of new water resources and water supply infrastructure and an investment in improved dam safety for state dams • Water Reconciliation Strategies in major urban areas and improved insights into reliable future water demands and supplies • A significant proportion of Reserve determinations have been done with different level of confidence • Incentive-based regulation through Blue and Green Drop assessments • Improved sector collaboration and participation • A Learning Academy to improve skills and capacity within the sector • Two Catchment Management Agencies established • Support given to numerous resource-poor farmers • Water sharing agreements and institutional arrangements in place in all trans-boundary basins	• Achievement of water conservation and water demand management targets • Streamlined water allocation reform to redress past racial and gender imbalances in access to water for productive uses and to address poverty and inequality • Implementation of environmental flow monitoring • Establishment of water management institutions and the decentralisation of water resources management • Strengthening of regulation of water resources and water quality • Improvement of technical and management skills to implement developmental water resource management • Improvement in the integration of monitoring and information management • Reduction in the backlog of infrastructure maintenance										

No.	Document Code	Document Type	Document Title	Document Author	Document Source and Download Date	Reason for inclusion	Data (excerpts, direct quotations, entire passages from documents)
25.	ID-SS3-NWRS-Ed3	Sector Strategy, NWRS Edition 3	DWASNWR S3	Department of Water and Sanitation Affairs, 2023	https://www.dws.gov.za/Documents/Gazettes/Approve%20National%20Water%20Resource%20Strategy%20Third%20Edition%20(NWRS3)%202023.pdf 15/11/2023	Key Strategy Document outlining objectives of the Department – responds to priorities set in the NDP To compare the provisions for water ecosystems management to NWRS1, 2 and achievements made to date since NWRS 1 and 2	Experts from several fields of study (such as fish biology, entomology, botany, geomorphology and chemistry) are required to monitor aquatic ecosystems in a holistic manner. Few, if any, organisations employ people covering this full suite of expertise. Therefore, to sustainably monitor the health of water ecosystems, cooperation and commitment across national, provincial and local organisations/agencies with water management mandates will be necessary. The design and maintenance of a monitoring and reporting programme can facilitate and encourage collaboration between the wide range of stakeholders involved in water ecosystem management.* 5.2 Principles The key principles to enable water resource protection are founded on ensuring that sufficient water is left in the rivers to sustain ecosystem functioning, that the quality of the resource is protected at the source and that the water environment has an intrinsic value for economic and social growth. Principle 1 Protection of the resource through classification of the resource with the Reserve¹ as a priority: The most critical resource protection imperative over the next five years is the use of the gazetted classification process to classify all the major rivers, wetlands and aquifers. This should involve stakeholder engagement to create ownership of water resources. The amount of water available to allocate will be determined after accounting for the Reserve, international obligations and the water requirements for power generation, which is considered a strategic sector. Principle 2 Water resource protection should be based on a participatory approach, involving users, planners and policymakers at all levels: The participatory approach to water resource protection should involve raising awareness of the importance and value of water among policymakers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the management of our water resources. Principle 3 The value of water resources must be recognised from an economic point of view and the social and environmental benefits of the resource: It is important that society recognises determining the economic value of water, accounting for the use of water (for example, household water supply and irrigation for agriculture) and the ecosystem services provided or supported by water resources (for example, nutrient cycling, habitat provision, and recreation). Principle 4 Water resource protection must guide setting conditions for water use authorisation: Water resource protection is effected through Resource Directed Measures (RDM), which set the goals for optimising the allocative efficiency of the water resource among its competing demands, and Source Directed Controls (SDC), which set abstraction and discharge licence conditions, financial and economic measures, and other regulatory processes for controlling water use. The potential impacts on the quality of the resource (this includes the quality of all aspects of the water resource, including water quality, the integrity of riparian and in-stream habitats and aquatic organisms), will be considered when granting a licence in order to ensure that water resources are protected. Principle 5 Incentive based protection of the water resources: To manage the quality of the water resource and protect the ecosystems, the waste discharge charge system must be used as an instrument to improve the quality of the degraded rivers wetlands and aquifers. Principle 6 Integrated protection of aquatic ecosystems: The complex and interconnected nature of catchments as social-ecological systems must be recognised and the aquatic ecosystem (water quantity and quality, habitat and biota) are to be managed in an integrated manner. 5.3 Objectives The key strategic objectives for water resource protection are to: • Ensure sustainable management of the water resources through resource directed measures and source directed controls. • 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. • Carry out rehabilitation of strategic water ecosystems. • Ensure prevention of water resources from point source and non-point source pollution by managing at source. • Create awareness among communities, business and decision makers about the value of water and ensure commitment to sustainable water use practices. • Create an enabling environment for water resource protection through incentive based approach to water resource management. • Monitor the ecological health of our resources through an integrated information management system. 5.4 Strategic actions 5.4.1 Manage for sustainability using resource directed measures A management class, and associated Reserve and resource quality objectives (RQO) have been set and approved for every significant water resource in the country. Resource quality objectives are regularly monitored for compliance, which informs enforcement and a strategic adaptive management cycle. Water ecosystems are maintained in the desired state. *The Reserve includes the water quantity and quality needed to maintain aquatic ecosystems in a particular state, as well as the water required to meet basic human needs. NWRS National Water Resource Strategy 43

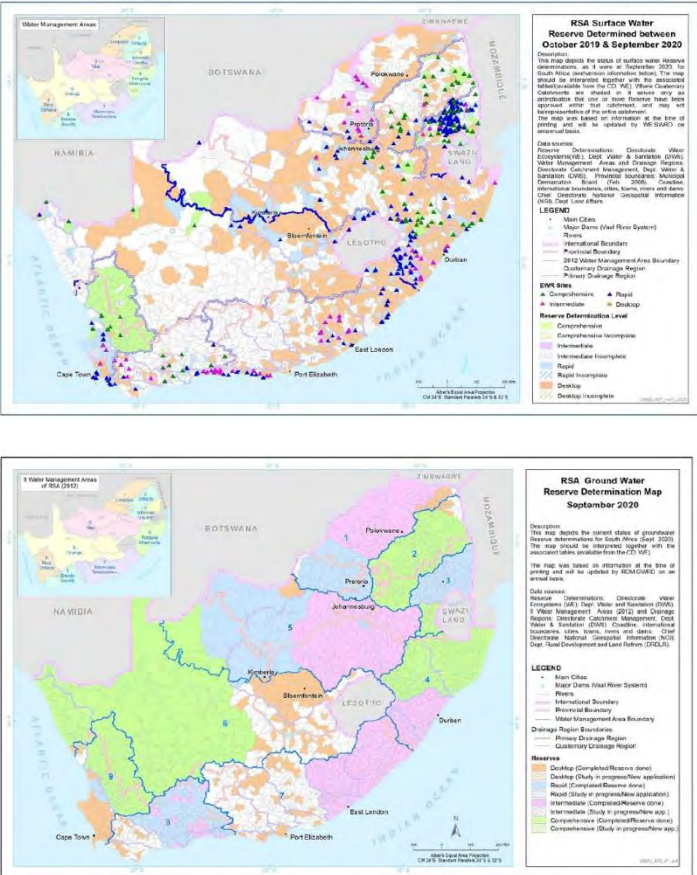
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26.	ID-SS3-IWQMS	Sector WQ Strategy, Integrated Water Quality Management Strategy (IWQMS)	DWS Integrated Water Quality Management Strategy	Department of Water and Sanitation, 2017	22/01/2021 https://www.dws.gov.za/iwqp/iwqms/Documents.aspx	Key sector strategy document detailing implementation challenges for water quality management which are applicable to RDM as water quality is a key aspect thereof	 <table><thead><tr><th>Goal</th><th>Strategic Issue</th><th>Strategic Objective</th><th>National / Provincial Priority</th><th>Comment</th></tr></thead><tbody><tr><td></td><td>11: Build WQ and WQM Capacity through Education, Training and Communication</td><td>11a: Sustained capacity for Government/CMA/sec tor to effectively manage and support WQM through improved education and training</td><td>National Provincial</td><td>In the technical arena of IWQM the need for qualified, skilled and competent staff is dire at national, provincial and local levels. The development of this capacity does not happen rapidly, and requires structured programmes with clear targets. This cuts across sectors and various government departments. This is a matter of absolute priority and was possibly the most discussed issue during the engagements on the strategy.</td></tr></tbody></table>	Goal	Strategic Issue	Strategic Objective	National / Provincial Priority	Comment		11: Build WQ and WQM Capacity through Education, Training and Communication	11a: Sustained capacity for Government/CMA/sec tor to effectively manage and support WQM through improved education and training	National Provincial	In the technical arena of IWQM the need for qualified, skilled and competent staff is dire at national, provincial and local levels. The development of this capacity does not happen rapidly, and requires structured programmes with clear targets. This cuts across sectors and various government departments. This is a matter of absolute priority and was possibly the most discussed issue during the engagements on the strategy.
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27.	ID-OP1-DWS APP-2021/22-2023/24	Institutional Document	Annual Performance Plan (DWS-APP)	Department of Water and Sanitation (DWS), 2021	https://www.dws.gov.za/Documents/RSP.aspx 09/11/2021	DWS business plan outlining annual targets for all units	<table><tr><th>Indicator Title</th><th>Number of river systems with water resource classes and determined resource quality objectives</th></tr><tr><td>Definition</td><td>This measures the number of river systems with water resource classes and determined resource quality objectives that provide the status of water quality and quantity, the habitat and biota characteristics of the river.</td></tr><tr><td>Source of data</td><td>Water resource databases supported by water resource classes gazettes and published resource quality objectives</td></tr><tr><td>Method of Calculation/ Assessment</td><td>This will be the gazetted water resource classes and resource quality objectives for the following river system:</td></tr><tr><td>Means of verification</td><td>Final gazette</td></tr><tr><td>Assumptions</td><td>Addressing concerns from stakeholder during the study may delay the finalisation of the study</td></tr><tr><td>Disaggregation of Beneficiaries (where applicable)</td><td>Not applicable</td></tr><tr><td>Spatial Transformation (where applicable)</td><td>Not applicable</td></tr><tr><td>Calculation type</td><td>Non-Cumulative</td></tr><tr><td>Reporting cycle</td><td>Quarterly</td></tr><tr><td>Desired performance</td><td>0</td></tr><tr><td></td><td>Review the implementation plan for the water resource classes and the RQOs (Thukela)</td></tr><tr><td>Indicator responsibility</td><td>Water Ecosystems Management</td></tr></table>	Indicator Title	Number of river systems with water resource classes and determined resource quality objectives	Definition	This measures the number of river systems with water resource classes and determined resource quality objectives that provide the status of water quality and quantity, the habitat and biota characteristics of the river.	Source of data	Water resource databases supported by water resource classes gazettes and published resource quality objectives	Method of Calculation/ Assessment	This will be the gazetted water resource classes and resource quality objectives for the following river system:	Means of verification	Final gazette	Assumptions	Addressing concerns from stakeholder during the study may delay the finalisation of the study	Disaggregation of Beneficiaries (where applicable)	Not applicable	Spatial Transformation (where applicable)	Not applicable	Calculation type	Non-Cumulative	Reporting cycle	Quarterly	Desired performance	0		Review the implementation plan for the water resource classes and the RQOs (Thukela)	Indicator responsibility	Water Ecosystems Management
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28.	ID-OP4-DWS RSP-2015/16-2019/20	Institutional Document	Revised Strategic Plan	DWS	www.dws.gov.za 07/03/2023	Revised Strategic Plan indicating action executed by the organisation	6.3 Organisational environment A number of changes within the internal organisational environment have been put in place to facilitate improved service delivery and further changes are anticipated during upcoming financial years. During the 2014/15 financial year, the department finalised its review of its organisational structure that required among other things the incorporation of the sanitation function and the infusion and streamlining of the activities of the regional offices (previously under the Regional and Implementation Support budget programme). In other words, all planning activities have been integrated, with water resources and water services infrastructure integrated in one programme and all regulation functions incorporated within the regulation budget programme. A separation has always been made of the activities that have been funded through the fiscus and those funded through the Water Trading Entity (WTE). In an effort of implementing its Institutional Reform and Realignment, the department undertook a rigorous exercise to separate its functions to those of the Catchment Management Agencies (CMAs). As the departmental provincial offices have been incubating proto - CMAs, with their anticipated establishment to fully fledged CMAs this separation is now prominent within the WTE section. The establishment of the CMAs will see a reduction in the budget and departmental staff over the next three to five years as functions and staff are transferred to the CMAs.																										
29.	ID-OP5-DWS RSP-2020/21-2024/25	Institutional Document	Revised Strategic Plan	DWS	www.dws.gov.za 07/03/2023	Revised Strategic Plan indicating action executed by the organisation	Joint National Wetland Management Policy: The policy recognises that wetlands are a critical source of water and for the natural biodiversity. For a semi-arid country like South Africa that receives below average rainfall of approximately 497mm, far below the world average of 860mm), wetlands become critical water factories and their protection is therefore priceless. Between 2016 and 2018 the DWS developed the Draft Wetland Policy from the 2016 Position Paper. After consultations, it was recommended that a Joint National Wetland Policy between the DWS and the Department of Forestry, Fisheries & Environment and the Department of Agriculture, Land Reform and Rural Development. The sustainable management of wetlands has also been recognised as a key activity that contributes towards achieving various national and international commitments, goals and priorities, including the National Development Plan (NDP)'s goal for an environmentally sustainable and resilient country, the 2030 Sustainable Development Goals (SDGs), the African Agenda 2063, international and national Climate Change mitigation and adaptation goals and the post 2020 Agenda set by the Convention on Biological Diversity, amongst others.																										

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30.	ID-OS-2014	Institutional Document	Organisational Structure	Department of Water and Sanitation (DWS)	https://cer.org.za/wp-content/uploads/2001/03/DWS-14-July-2017.pdf 09/11/2021	DWS Organisational Structure Indicating a dedicated Chief Directorate for the RDM functions	RDM Chief Directorate (now Water Ecosystems Management) consists of the Reserve, Water Resource Classification and Sources Directed Studies 
31.	ID-AR1-DWS-AR	Institutional Document: DWS Annual Report	DWS Annual Report	DWS, 2019/20	https://www.dws.gov.za/documents/AnnualReports/AnnualReport2019-2020_08March2020.Rev02.pdf 09/11/2021 05/02/2022	Key report providing progress on an annual basis against the sett APP targets	

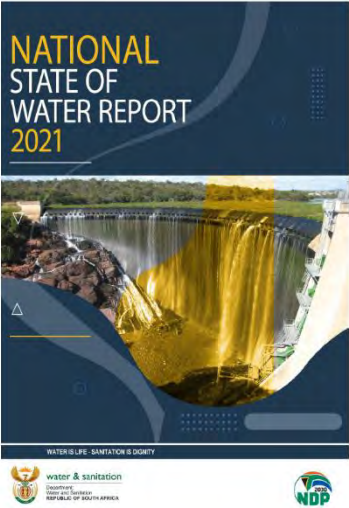
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32.	ID-NSoW1-2019/20	Institutional Document: DWS Annual Report	National State of Water Report for South Africa	DWS, 2021	https://www.dws.gov.za/Projects/National%20State%20of%20Water%20Report/Document/s/Final%20Reviewed%20NSoW%20Report%202019-20_approved.pdf 09/11/2021	Key report providing an annual status of water in the country for the period 2019 to 2020; including maps on extend of Classes, RQOs, Reserve determination so far NSoW, Page 118: “The implementation of RDM has linkages to a number strategies and activities such as water allocation, water regulation, water use authorisations, compliance monitoring and enforcement, and importantly to the second complementary approach to sustainable water resource management which is the SDCs (DWS, 2021). The SDCs, are aimed at the control of impacts into the water resource using regulatory measures (Odume et al., 2018). The regulatory measures include general authorisations (GA), compulsory water use licencing (WUL), waste discharge charge system (WDCS), economic incentive programme and penalties (e.g., Green.	 <i>Status of WRC and RQOs determination Post 2010 to September 2020</i> <i>Table 5-2 Overview status of WRC and RQO determination post 2010 to September 2020</i> <table><tr><th>Study Area</th><th>Status</th><th>Government Gazette No.</th></tr><tr><td>Olifants-Doorn</td><td rowspan="5">The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.</td><td rowspan="5">GG 39943 of 22 April 2016</td></tr><tr><td>Olifants</td></tr><tr><td>Upper Vaal</td></tr><tr><td>Middle Vaal</td></tr><tr><td>Lower Vaal</td></tr><tr><td>Letaba</td><td rowspan="2">The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.</td><td rowspan="2">GG 40531 of 30 December 2016</td></tr><tr><td>Inkomati</td></tr><tr><td>Mvoti to Mzimkhulu</td><td>The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.</td><td>GG 41306 of 08 December 2017</td></tr><tr><td>Crocodile (West) Marico, Mokolo, and Matlabas</td><td>The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.</td><td>GG 42775 of 18 October 2019</td></tr></table>	Study Area	Status	Government Gazette No.	Olifants-Doorn	The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.	GG 39943 of 22 April 2016	Olifants	Upper Vaal	Middle Vaal	Lower Vaal	Letaba	The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.	GG 40531 of 30 December 2016	Inkomati	Mvoti to Mzimkhulu	The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.	GG 41306 of 08 December 2017	Crocodile (West) Marico, Mokolo, and Matlabas	The Department finalised and gazetted the water resource classes together with the associated resource quality objectives.	GG 42775 of 18 October 2019
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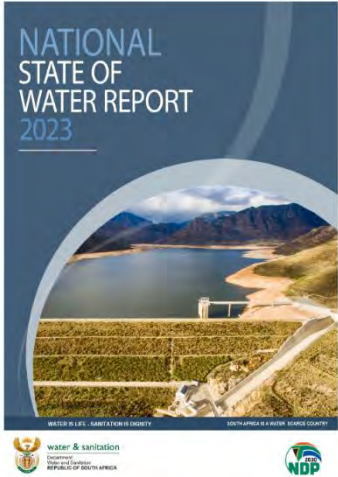
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						Water Act, 36 of 1998.....The National Department of Water and Sanitation is the custodian of water resources with an obligation of water resource management DWS acting through the Minister is responsible for water sector policy, support, and regulation. This water resource management obligation or function is to be delegated to an institution at the water management area level such as a Catchment Management Agency (CMA), this is in support of the principles of integrated water resource management. In water management areas where a CMA has not been established the responsible authority (DWS national and regional) continues to act as a CMA to perform all water resource management functions at a catchment level".	magnitude of the impact on water resources, and the quantity and quality of data available to run the models. Reserves for surface water resources (i.e., rivers, wetlands, and estuaries) have been determined at a desktop, rapid, intermediate, and comprehensive level. Similarly, the Reserve for groundwater resources (aquifers) have also been determined at a desktop, rapid, intermediate, and comprehensive level". DWS (2021), NSoW, p7-9: "the NWRS2 established the nine WMAs in South Africa, as from July 2012 (Figure 1.1); these replaced the 19 WMAs identified prior to this date. It was recognised that these WMA boundaries needed to be reviewed periodically to accommodate new realisations and issues. WMAs are largely based on catchment boundaries, except for those catchments that cross international borders". This report also details new proposed WMA demarcations and their incorporation into CMAs: "The Department has embarked on several institutional re-alignment processes with the aim of transforming the water sector and building stable institutions with clearly defined roles and responsibilities across the sector and promoting effective institutional performance. It is proposed that going forward water resource management will be based on six water management areas for which CMAs will be established, these are: Limpopo-Olifants (1); Inkomati-Pongola (2); Mhlatuze-Mzimkhulu (3); Vaal-Orange (4); Mzimvubu-Tsitsikamma (5); Breede-Olifants (6) As part of the Department's turnaround strategy in establishing CMAs, the extension of the boundary of the existing Breede-Gouritz CMA to incorporate the Berg-Olifants water management area has been gazetted for public comments in terms of section 78(1) of the National Water Act, 1998 (Act No. 36 of 1998) to establish the Breede-Olifants CMA in September 2020. While in March 2021, the extension of the Vaal CMA to include the Orange water management area has been gazetted for public

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							consultation in terms of section 78(4) of the National Water Act, 1998 (Act No. 36 of 1998). This incorporation will enhance revenue generation and sustainability of the CMA, as well as enabling an effective water resources management”. <u>Quote from National State of Water Report, page 118:</u> “The implementation of RDM has linkages to a number strategies and activities such as water allocation, water regulation, water use authorisations, compliance monitoring and enforcement, and importantly to the second complementary approach to sustainable water resource management which is the SDCs (DWS, 2021). The SDCs, are aimed at the control of impacts into the water resource using regulatory measures (Odume et al., 2018). The regulatory measures include general authorisations (GA), compulsory water use licencing (WUL), waste discharge charge system (WDQS), economic incentive programme and penalties (e.g., Green, and blue drop programme, levies and fees), and compliance and enforcement actions such as directives and prosecution to ensure that the RQOs are met. The mandate of reporting on the compliance to the reserve and RQOs and the achievement of Water Resource Classes resides with Chief Directorate: Water use and Compliance Monitoring. The compliance to RQOs results will start to be made available for reporting from the hydrological year 2021/22 based on the currently piloting of monitoring compliance to RQOs with a specific focus on surface water quality. Although RQOs have four drivers (quality, quantity, habitat and biota), in future all four drivers for both surface and groundwater will be reported. The successful implementation and monitoring of RQOs and Reserve will not only allow effective protection and management of water resources but will also assist in decision making for resource allocation. The Department is undertaking monitoring of compliance to the RQOs to assess if the standard and quality of the resource is improving or declining based on the set RQOs for the specific resource, the aim is to see the resource improving and the RQOs being implemented. These will allow water resource managers to manage demands on water resources and it will also make decision making easier” DWS (2021).

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33.	ID-NSoW2-2021	Institutional Document: DWS Annual Report	National State of Water Report for South Africa	DWS, 2023	https://www.dws.gov.za/Projects/National%20State%20of%20Water%20Report/Documents/National%20State%20of%20Water%20Report%202021new.pdf 05/10/2022	Key report providing an annual status of water in the country for the period 2021 to 2022; including maps on extend of Classes, RQOs, Reserve determination so far	

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34.	ID-NSoW3-2023	Institutional Document: DWS Annual Report	National State of Water Report for South Africa	DWS, 2024	https://www.dws.gov.za/Projects/National%20State%20of%20Water%20Report/default.aspx 03/05/2024	Key report providing an annual status of water in the country for the period 2022 to 2023; including maps on extend of Classes, RQOs, Reserve determination so far	
35.	ID-PR1-WRC-TT 838/1/20	Report to the WRC Report No.TT 838/1/20	Case study for linking water quality license conditions with resource quality objectives for the Leeutaibos chspruit industrial complex situated within the Vaal Barrage Catchment	Oghenekaro Nelson Odume, Andrew Slaughter, Neil Griffin and Asanda Chili, 2021	http://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/TT%20838-1%20final%20web.pdf 11/03/2022		This study arises from the realisation that the understanding of the link between the resource quality objectives and the discharge standards in water use licenses was not clear to water resource users within the Vaal Barrage catchment. Clarifying this link between the RQOs and WUL was important because these are legal instruments used by the DWS to ensure water resource use and protection. In Chapter 3 of the study, current practices related to WUL and RQOs were reviewed, and it was concluded that current methods used for setting end-of-pipe discharge standards were robust, but with several shortcomings. These shortcomings included the non-consideration of the differences between conservative and non-conservative water quality variables, the non-consideration of upstream waste loads on downstream resource users and RQOs, the non-consideration of the contribution of diffuse pollution sources to instream waste loads, which is critical for a highly developed catchment such as the Vaal Barrage catchment, and the setting of receiving stream concentrations for toxic substances at zero (0) and reference conditions for system variables, which could be unrealistic given the developed nature of the Vaal Barrage catchment.

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36.	ID-PR2-WRC-2345/1/18	Report to the WRC WRC Report No.2345/1/18	A Conceptual Framework for Using Historical Information When Monitoring Resource Quality Objectives	KARL REINECKE, ROZWI MAGOBA, CATE BROWN AND ALISON JOUBERT, 2018	http://wrcwebsite.azurewebsites.net/wp-content/uploads/docs/23451.pdf 11/03/2022	The recommendations from this study are that assessments of the available historical data should be done for every catchment in the country, and made available to DWS for interpreting their monitoring data and guiding their management of the rivers. Not only information vital for interpreting and augmenting data already incorporated into the REMP and RQO studies, but the nature and content of such assessments make them for postgraduate study. They are relatively straightforward but necessitate a rare procedures and skills, and would provide postgraduate students with a deep understanding the nature and timing of human impacts on rivers, how the river ecosystems respond to historical context in which they should be managed, which would be invaluable in their own careers. The invertebrate data and some of the contextual maps generated in this project are in the Freshwater Biodiversity Information System, managed by the Freshwater Res Centre (www.frcs.org.za).	The main sources of data on whether or not the Ecological Reserve is being correctly implemented in a catchment, and its efficacy in sustaining the RQOs for that catchment, are intended to be the REMP and the RQO monitoring programmes (DWS 2013). For the most part, these focus on sites established in Reserve determination studies, and use the hydrological and ecological information developed in those studies as benchmarks for ongoing monitoring. While this pragmatic approach is understandable, it is important to recognise that the data collection and analyses done for the Reserve determination studies were not necessarily aimed at providing historical baselines for ongoing monitoring. This is particularly so for the REMP indices, which are assessed according to change from "reference" conditions, and therefore depend on a robust definition of reference conditions. As such, the premise upon which this study was based is that data from the Reserve studies will benefit from being contextualised within a broader historical and catchment-based perspective, particularly with regards to the description of more robust and defensible definitions of baseline/reference conditions on which to base monitoring. This study demonstrated the value gained by investing in the collation and analysis of historical data in a simple, cost-effective manner and how this may be used to augment Reserve and monitoring data to provide a more robust definition of reference conditions for REMP indices and the interpretation of RQO monitoring data, and to provide a quantitative basis for what are otherwise highly subjective assessments. Information was gathered from wherever it could be found and then tested to see if it was useful in interpreting change in the Berg River. The study provided valuable lessons in making the most of data with irregular coverage, in patching data to ensure that it could be analysed, in combining data from different temporal and spatial scales, and in applying scales broader than those routinely considered in Reserve determinations or monitoring studies to augment the assessments required. There was more information available without charge than originally envisaged and so, with hindsight, the main investment was the time taken to collate and analyse it all. Furthermore, the insights gained greatly increased our understanding of the functioning of the Berg River ecosystem and the factors at play in its continuing management.
37.	OD-MP1-REMP	Monitoring Programmes	DWS Website	DWS RQIS Monitoring Programmes	http://www.dwa.gov.za/iwqs/rhp/default.aspx 09/11/2021	- Implementation of Monitoring Programmes at HO RQIS, Regional Offices and CMAs	HO RQIS: National Aquatic Ecosystem Health Monitoring Programme (NAEHMP) includes the River Eco-status Monitoring Programme (REMP). The REMP focuses on the monitoring of the ecological conditions in river ecosystems as it is reflected by the system drivers and biological responses (instream and riparian). RO: Implementation of ecological and user requirements and through regulation programmes: SDCs/pollution prevention measures, water use authorisations, water allocation measures => decentralising function which can enable community involvement Interpretation of RDM project outcomes for incorporation into license conditions (WRC, 2018: Case Study on linking RQOs and Site-specific conditions)

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							<table><tr><td>BRANCH: REGULATION, COMPLIANCE AND ENFORCEMENT</td></tr><tr><td>Aim: To regulate and licence water use, ensuring equitable allocation, protection and beneficial use of water</td></tr><tr><td>Functions:</td></tr><tr><td>1. The regulation of water tariffs</td></tr><tr><td>2. The allocation of water through the authorisation of water use licences</td></tr><tr><td>3. The determination and monitoring of water quantity/quality standards</td></tr><tr><td>4. The determination of dam safety regulations, standards and monitor compliance thereof</td></tr><tr><td>ESTABLISHMENT:</td></tr><tr><td>1 DDG: Regulation, Compliance and Enforcement PL 15</td></tr></table>	BRANCH: REGULATION, COMPLIANCE AND ENFORCEMENT	Aim: To regulate and licence water use, ensuring equitable allocation, protection and beneficial use of water	Functions:	1. The regulation of water tariffs	2. The allocation of water through the authorisation of water use licences	3. The determination and monitoring of water quantity/quality standards	4. The determination of dam safety regulations, standards and monitor compliance thereof	ESTABLISHMENT:	1 DDG: Regulation, Compliance and Enforcement PL 15
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38.	OD-MPR2-SoR1	Monitoring Programme Report – Institutional?	DWS Website	DWS RQIS, 2019 REMP: State of Rivers Report	http://www.dwa.gov.za/iwqs/rhp/state_of_rivers/annual_State_of_Water_2017_2018_hydro_year_updated_FINAL_2019_10_11_web.pdf 09/11/2021	River Ecstatus Monitoring Programme State of Rivers Report for the period 2017-2018 with details on the REMP status quo	Challenges including: • Data gaps • Capacity constraints • Pollution from WWTWs = poor water quality in Rivers									

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							Rivers in densely populated areas were in poor condition due to the lack of proper management and maintenance of waste water treatment works and insufficient capacities of these works for the population served. Furthermore, many rural areas still lack proper sanitation. Proper and well-managed sanitation solutions should thus be given priority in the country. Waste discharge poses major risks for aquatic and human health and is one of the largest contributors to the deterioration of water resources. Many sites are currently not sampled. A major portion of these sites are inactive due to access problems or unsuitable flow conditions; Plate 3 gives an illustration of these challenges. Sites could not be accessed because of problems obtaining permission from private land-owners or due to blocked or damaged roads. The majority of sites that were not sampled due to unsuitable flow conditions will be re-activated once the river flows have normalised. Certain sites, particularly some of the sites in the Vaal and Orange catchments are too ephemeral in nature and will have to be discontinued altogether for the in-stream assessments. These sites will only be used for riparian assessments in future. The habitat at some sites was altered to such an extent that it has become impossible to do macroinvertebrate assessments. There were health and safety concerns at 12 sites. Two sites have been discontinued due to the consistent high level of raw sewage, which constitutes a major health risk to staff. The majority of inactive sites with safety concerns are located in nature reserves of game farms where wild animals pose a potential risk to the samplers. The safety concerns may be addressed to a certain extent by providing wildlife awareness courses to the sampling teams or providing them with a trained, experienced and armed game guard. These interventions will however come at a cost. A lack of capacity remains a major challenge with implementing the REMP. At this stage only the macroinvertebrates are monitored regularly in all the WMAs. Another difficulty is the need for training of regional staff in running the EcoStatus models. A systematic training process is under way, but it has time and cost implications. Financial constraints are a major challenge in the implementation of the REMP. The recent cost-cutting measures implemented in the department necessitated the reduction in the number of sites monitored. Further financial implications are related to the procurement of essential sampling equipment and Personal Protective Equipment (PPE), without which sampling cannot take place. Riparian zones and instream habitats, which are beneficial to the environment and humans, have deteriorated because of land use activities. In addition to supporting diverse fauna and flora, intact habitats provide goods and services to surrounding communities. An intact riparian zone can buffer the effects of temperature increases on instream habitats, and helps in reducing erosion. Everyone needs to contribute to sustainable solutions in this space. Municipalities need better and greener town planning and improved service delivery to densely populated areas. Mining companies need to be held accountable where there has been improper management of mining activities. Compliance and enforcement measures need to be tightened, for example on illegal sand and diamond mining prevalent in Eastern Cape and Northern Cape. Sustainable agricultural practices are encouraged, where preserving of biodiversity and protection of the environment are practised with reduced use of fertilisers and water. Other environmentally-friendly farming methods include drip irrigation, low tillage to reduce erosion and water use, and crop and livestock rotation to improve water quality and increase carbon sequestration. To solve implementation challenges, the River Ecosystem Monitoring Programme needs to be well resourced. The provinces with limited resources will need support until they are able to implement the programme independently. Integrated Water Resource Management is a necessity for the successful management of any type of water resource. Strong government, private and public inter-relations are needed for promoting the values of the National Water Act: protection, management, and equitable and sustainable use.

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39.	OD-PR-IRR1-Olifants-Doorn	Project Document	Olifants Doorn Classification Study Issues and Response Register (IRR)	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 10/07/2021	Key project document detailing issues/comments/queries raised by stakeholders during the course of the project at different stakeholder platforms	- According to the assumptions made, what if the data is not correct? - What data do we use? There's a study that was done 2 years ago.
40.	OD-PR-IRR2-Vaal	Project Document	Vaal Classification Study IRR	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 10/07/2021	Key project document detailing issues/comments/queries raised by stakeholders during the course of the project at different stakeholder platforms	- <i>The classification of water resources is very complex and it remains largely untested, because it is very new in South Africa. The business sector wants to see a robust and defendable classification system.</i> - Non-Governmental Organisations (NGOs) make significant financial sacrifices to attend meetings such as this PSC, because no compensation is paid out for time, travel or accommodation. - <i>The SANBI has information available in the study area that could be useful to the study team.</i>
41.	OD-PR-IRR3-Olifants	Project Document	Olifants Classification Study IRR	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 10/07/2021	Key project document detailing issues/comments/queries raised by stakeholders during the course of the project at different stakeholder platforms	- <i>We (DWA) have information that we can share with the study team.</i> - <i>The mines in the Steelpoort area have a lot of water quality information that can be used by the study team. Most of this information is given through to the DWA, but he is not certain how it is being applied by the DWA. He will collect the information and pass it on the study team.</i> - <i>International commitments have been accounted for in the yield model used in the Reconciliation Strategy.</i>
42.	OD-PR-IRR4-Letaba	Project Document	Letaba Classification Study IRR	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 10/07/2021	Key project document detailing issues/comments/queries raised by stakeholders during the course of the project at different stakeholder platforms	- <i>The scenarios being investigated as part of the Reconciliation Strategy for the area should be noted by the members of the PSC. Several transfers are being investigated (e.g. a pipeline being constructed to transfer water from Luvuvhu to Giyani and options to develop the Klein Letaba). These scenarios are being investigated as it was found (amongst other) that the Middle Letaba is being over utilised. Future scenarios will have to take such findings as well as the visioning of stakeholders into consideration.</i> - <i>Were the impacts of invading alien plants in the scenarios investigated? Valuable information is available from the Sabie River Working Group and Mondli. They have looked at their</i>

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							<i>plantation management plans, making sure to steer clear from water resources.</i>
43.	OD-PR-IRR5-CrocWest	Project Document	Mokolo, CrocWest and Marico Classification Study IRR	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 10/07/2021	Key project document detailing issues/comments/queries raised by stakeholders during the course of the project at different stakeholder platforms	- <i>Crocodile Reconciliation study indicated that high inflow from the WWTWs and Gauteng area is adding surplus of water into the Crocodile West Marico River system. Upstream of WWTWs and Haartebeespoort Dam, treating water downstream of the dam is costly for the municipality. It is important to ensure treatment of water quality before reaching Madibeng municipality area.</i> - <i>Regional office must come up with planning as they will be doing the monitoring. She understands that Regional offices have been swamped with a lot of responsibility and the delay in the establishing CMAs is one of the problems, because they find themselves carrying out the functions of the CMAs as well as their own duties.</i> - <i>In the Region, currently, we do not have the capacity to implement RQOs in relation to WULA. We need a model to assist us in terms of water allocation to different users.</i>
44.	OD-PR-IRR6-Mvoti	Project Document	Mvoti Classification Study IRR	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 10/07/2021	Key project document detailing issues/comments/queries raised by stakeholders during the course of the project at different stakeholder platforms	- <i>The NWA is one of the best legislation in the world, but we are still lacking behind in terms of implementation.</i> - <i>When is the Gazetted MC, Reserve & RQOS going to be reviewed, is it stated in the legislation?</i> => <i>the timeframe for the review is not stipulated in the legislation. That will depend on the Minister when she sees fit, unless is indicated on the gazette document.</i>
45.	OD-PR-IRR7-Inkomati	Project Document	Inkomati Classification Study IRR	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 10/07/2021	Key project document detailing issues/comments/queries raised by stakeholders during the course of the project at different stakeholder platforms	- <i>It is confusing that the Reserve study was undertaken six years ago and the classification study is currently being undertaken. These processes need to complement each other.</i> => <i>the preliminary Reserve will be relooked at and confirmed through this study, thus the processes do complement each other.</i> - <i>It is understood that the Usuthu River will become part of the Inkomati catchment but that it is not within the scope of this study. Should the Usuthu River not be included as part of this process?</i> => <i>when this project was initiated the boundaries were still under consideration which is why the Usuthu River is not part of this study area. Considering that Usuthu River might become part of the Inkomati WMA, the DWA has initiated the process to include the Usuthu River. However, the Usuthu River is not part of this</i>

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							contract and this specific study. The information presented at this meeting is confusing. It is suggested that the information presented at the meeting be simplified and presented at the respective local forums which have already been established. The use of jargon puts most stakeholders in a powerless position as they cannot fully participate in discussions regarding the study. The presentations and discussions would be simple to understand if it was carried out in their home language (SiSwati).
46.	OD-PR-IRR8-Mzimvubu	Project Document	Mzimvubu Classification Study IRR	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 10/07/2021	Key project document detailing issues/comments/queries raised by stakeholders during the course of the project at different stakeholder platforms	- People on the ground do not understand the Classification project. He further stated that he has noted from his personal experience that people on the ground tend to be excluded during the initial stages of the project. => due to the technical nature of the project, the approach is to hold PSC meetings which are then supported by dedicated sessions focussing on Catchment Management Forums (CMF) in the study area. CMF meetings require careful and structured use of language so as to be able to coherently address the issues to the people on the ground effectively. Inviting community members to platforms such as PSC is not always the best option. The study team will be attending the CMF meetings to present the status of the project and provide continuous updates to the people on the ground. - She foresees a situation where all of the technical work will be done and then ordinary people will have to input into what they want their catchment to be like. This comes at the time when the Catchment Management Agency (CMA) is developing the Catchment Management Strategy (CMS) with the development of a vision. In addition, this work is done in a catchment where the Catchment Management Forums (CMF) are emergent. - He is interested to know what prompted the decision to exclude Tsitsikamma because DWS is still responsible for the whole WMA? =>DWS aims to look at significant river systems. It was decided that the Tsitsikamma portion of the WMA will have to be dealt with at a later stage as there are studies currently being undertaken that necessitated its exclusion from the current Mzimvubu study. As such, Tsitsikamma is not included in this current study. The study area consists of the Mzimvubu River and its tributaries as depicted on the study area map. Dr Patsy

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							<i>Scherman confirmed that the study area is the T3 Mzimvubu Catchment, and not the entire Tsitsikamma to Mzimvubu WMA. =>There is definitely an intention to cover what is still outstanding, but due to resource constraints, they are not moving as fast as they would have wanted to because if they do not finalise the Reserves, they end up having to deal with desktop Reserves, thus affecting the delivery time of the issuing of licences.</i>				
47.	OD-PR-SI&CT	Project Document	Stakeholder involvement and communication tool analysis and standardisation Report	DWS	https://www.dws.gov.za/RDM/WRC/S/default.aspx 11/11/2024	Project document detailing development of Procedures to Operationalise Resource Directed Measures	2.3.1 Why does DWS engage stakeholders in the RDM processes? RDM guideline documents emphasise the need of stakeholder engagement throughout the implementation of such processes, as the outcomes of such processes will affect both ecosystem health and the economic activities that rely on water supply. It is recognised that RDM processes, especially the classification of water resources requires a strongly driven stakeholder involvement and communication component supported and guided by the necessary technical and communication components. As noted in the DWAF Generic Public Participation Guidelines (DWAF 2001), the term "public participation" or "stakeholder engagement" describes a variety of relationships between the implementing agency (DWS or Catchment Management Agencies - CMAs) and its stakeholders. The nature of a planned stakeholder engagement process will depend on what is planned and the goal of the initiative. The International Association for Public Participation (IAP2) differentiates between five levels of public participation, each with different objectives and with an increasing public impact on decision-making (www.iap2.org): Table 2.1 Sectors of water users which should be included in a stakeholder list <table><tr><th colspan="2">Sectors of water users</th></tr><tr><td> ✓ Government (national, provincial and local, all relevant departments). ✓ Traditional leaders. ✓ Conservation and environmental bodies. ✓ NGOs (environmental and development-focused). ✓ Commerce and business. ✓ Industry. ✓ Mining. ✓ Agriculture. ✓ Forestry. ✓ Tourism and recreation. </td><td> ✓ Civil society (voluntary organisations, community groupings, residential organisations, women's organisations, youth organisations). ✓ Local community leaders. ✓ Labour unions. ✓ Researchers and consultants. ✓ Local media (print and broadcast). ✓ Water management institutions. ✓ Education bodies. ✓ Health bodies. ✓ Departmental personnel in the DWS National as well as Regional Offices. </td></tr></table>	Sectors of water users		✓ Government (national, provincial and local, all relevant departments). ✓ Traditional leaders. ✓ Conservation and environmental bodies. ✓ NGOs (environmental and development-focused). ✓ Commerce and business. ✓ Industry. ✓ Mining. ✓ Agriculture. ✓ Forestry. ✓ Tourism and recreation.	✓ Civil society (voluntary organisations, community groupings, residential organisations, women's organisations, youth organisations). ✓ Local community leaders. ✓ Labour unions. ✓ Researchers and consultants. ✓ Local media (print and broadcast). ✓ Water management institutions. ✓ Education bodies. ✓ Health bodies. ✓ Departmental personnel in the DWS National as well as Regional Offices.
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							2.3.4 Which communication methods are currently used by the DWS in the RDM processes? The communication methods currently used by the DWS in the RDM processes are listed in the following sections per framework step. These methods are evaluated and comments made during the workshop are listed. Some general comments which are not listed per step are: ▪ In the development of a stakeholder list, caution should be taken to include all relevant stakeholders from the beginning of the process in order to ensure that contributions are included throughout the process and not only towards the end. ▪ The DWS considers the use of various languages in their communication material where necessary. ▪ Record-keeping of contributions received throughout the process is essential. The compilation of a Comments and Responses Report (CRR) is recommended to indicate which stakeholder has contributed which comments when in the process and how the DWS and technical responded to the contribution made. ▪ The information shared with stakeholders is fairly technical in nature and DWS should always attempt to make the information as accessible as possible to all audiences. It was recommended that when meetings are held that representatives of the regional office be present to address pressing local issues such as service delivery. ▪ The stakeholder engagement process should adhere to minimum requirements (e.g. accessibility of information, providing information prior to meetings for comments, sufficient time allowance for commenting purposes, etc), but each process should be adapted to a specific process for a specific catchment area. The challenge is to design a process based on a prior evaluation of public sensitivity, and local catchment needs and circumstances. ▪ RDM processes should be integrated into other opportunities available, e.g. at regular water forum or catchment forum meetings matters about RDM processes should be on the agenda for discussion when relevant. ▪ Communication and stakeholder engagement is often about trust and credibility; about the way or manner, or "how" communication takes place – should sensitive situations arise, use experienced communicators to engage with stakeholders. ▪ Cost of stakeholder engagement should be determined per study area. Always look for alternatives and "piggy-back" on existing opportunities (e.g. if a meeting is scheduled, use the same meeting to discuss RDM processes); ▪ Make the "rules of engagement" or the ToR for groups clear from the start – this assists with understanding the roles of various roleplayers, their rights and responsibilities.