University of KwaZulu-Natal

Examining Marine Water Quality Management in South African Seaports

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DECLARATION

I Simphiwe Innocentia Mazibuko declare that:

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ABSTRACT

South Africa's eight commercial seaports are owned and managed by Transnet National Ports Authority (TNPA). TNPA's vision includes a systematic improvement of the environment in which ports operate and have influence over. Environmental aspects identified within TNPA are ranging from port operation such as cargo handling, dredging, ballast water discharge, hull cleaning, rivers, canals and storm water drains discharging into the bay. The National Ports Act (No. 12 of 2005) stipulate that the Port Authority must regulate and control pollution and the protection of the environment within the port limits. Effective marine water quality management is required for good corporate governance, sustainable development and economic functioning of the South African seaports system. This study has three objectives. First, to examine the current marine water quality management practices in South African seaports. Second, to examine the contributing factors to marine water quality in South African seaports. Lastly, to examine current and proposed marine water pollution prevention strategies in South African seaports. Purposive sampling was used to ensure that only those with practical knowledge of the study area and experience in marine water quality management (ten from Transnet National Ports Authority, two from Council for Science and Industrial Research, and two from South African Maritime Safety Authority), were selected in this study to share views through semi-structured and face-to-face interviews. As the number of the interviews were only fourteen, data was manually analysed using open coding and constant comparison to generate themes which reflected on marine water quality management in South African seaports. The study revealed that bi-annual ecological monitoring is conducted across all eight ports. Contributing anthropogenic factors ranging from sewage discharge, storm water run-off from residential and industrial areas to catchment areas such as rivers and canals were identified. Ship repair and cargo handling operations were also identified as the main contributors to marine water quality. The study also revealed that partnerships between ports and the local municipalities to manage the anthropogenic factors was viewed as a critical support element to minimise the impact on marine environments. Therefore, the study recommends that the ports conduct impact assessments of ship repair operations on the marine environment. It is also recommended that an integrated maritime industry forum be established to discuss and make holistic decisions that would improve marine water quality management in South Africa's ports.

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LIST OF ACRONYMS AND ABBREVIATIONS

BCLME	Benguela Current Large Marine Ecosystem
CBD	Convention on Biological Diversity
CMPs	Coastal Management Programmes
CSIR	Council for Scientific Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DEAT	Department of Environmental affairs and Tourism
DOT	Department of Transport
DWA	Department of Water Affairs
DPE	Department of Public Enterprise
DPME	Department of Planning, Monitoring and Evaluation
EMS	Environmental Management System
EMP	Estuarine Management Plan
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOOS	Global Ocean Observation System
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
IOC	Intergovernmental Oceanographic Commission
IISS	International Institute for Strategic Studies
MDG's	Millennium Development Goals
MoU	Memorandum of Understanding
MPA's	Marine Protected Areas

MSP	Marine Spatial Planning
NDP	National Development Plan
NPC	National Planning Commission
NMMU	Nelson Mandela Metropolitan University
OOS	Oceans Observations and Services
RSA	Republic of South Africa
SADC	Southern African Development Community
SAHRA	South Africa Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SAMSA	South African Maritime Safety Authority
SAIMI	South African International Maritime Institute
SAWS	South African Weather Services
SAEON	South African Environmental Observation Network
SEA	Strategic Environmental Assessment
SDG's	Sustainable Development Goals
SOC's	State Owned Company
SOLAS	Safety for Life at Sea
SST	Sustainable Seas Trust
TNPA	Transnet National Ports Authority
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNCLOS	United Nations Convention on the Law of the Sea
UNESCO	United Nations Educational, Scientific and Cultural Organization

UNEP	United Nations Environment Programme
WHO	World Health Organization
WWF-SA	World Wide Fund for Nature South Africa

CHAPTER ONE

INTRODUCTION

1.1 Background, motivation and focus of the study

South Africa's shoreline has been predominantly used for marine conveyance and collection of marine living resources (DEA, 2014a). South Africa's eight commercial seaports, namely; Port of Richards Bay, Port of Durban, Port of East London, Port of Ngqura, Port of Port Elizabeth, Port of Cape Town, Port of Saldanha and Port of Mossel Bay are owned and managed by Transnet National Ports Authority (TNPA). Notably, in 2016, the commercial ports handled over 224 million metric tons, 4.3 million TEUs and had 11199 vessel arrivals (TNPA, 2017). In 2017, the country's eight commercial ports handled over 227 million metric tons, 4.63 million TEUs, and had 9 821 vessel arrivals (TNPA, 2018). Furthermore, in 2018, the commercial ports handled over 228 million metric tons, 4.88 million TEUs and had 9202 vessel arrival (TNPA, 2019). Clearly, the country depends on these eight ports to facilitate international trade (Gumede and Chasomeris, 2018; Walker, 2018). TNPA has been entrusted by the Government of the Republic of South Africa to efficiently and effectively manage, control and administer the economic functioning of the national ports system as a landlord port. TNPA supports economic growth, and with South Africa's economy being reliant on port traffic of imports and exports, the national port system needs to increase its capacity (TNPA 2017).

As early as the 15th century, marine transportation and marine living resources consumption demonstrated its importance (DEA, 2014a). It continues to do so as it endures modern significant uses of the marine environment. The South African seaports system was predominantly developed for the importation and exportation of goods; such as, commercial vessel berths in the ports system to facilitate trade. Prominent environmental aspects identified within the TNPA operations are marine pollution, poor waste management, and air emission issues, and many more. Marine pollution occurs due to various internal and external activities; these marine pollution sources range from port operations such as ship repair activities, cargo handling, dredging, ballast water discharge and hull cleaning to rivers, canals and storm water drains discharging into the bay (TNPA, 2010). Section 11(1) (g) of the National Ports Act stipulates that the Ports Authority must "regulate and control pollution and the protection of the environment within the port limits" (RSA, 2005, p.14).

According to Derraik (2002) and DEA (2012) threats to marine life in the ocean emanates from numerous practises such as, but not limited to; dumping of waste, pollution, overexploitation and harvesting, aquatic invasive species, global climate change, dredging and land reclamation. CSIR (2013) indicate that seaports are located in sensitive coastal and marine environments and are diverse in locations, surroundings, activities and regulatory administrations. Challenges of minimising impacts associated with port operations particularly to avoid causing long term and irreversible environmental damage are a reality for seaports (GHD, 2013; Hovey et al., 2015). The Port Rules, promulgated under section 80(2) of the National Ports Act outlines the environmental management requirements and monitoring programmes that must be implemented during port operations to minimise potential environmental impacts (RSA, 2005; 2009).

CSIR (2017, p. 1) indicate that "recognising the risks posed to the ecological functioning of the aquatic environment in South African ports by port associated activities and by activities in adjacent urban areas, TNPA has implemented the Long-Term Ecological Monitoring Programmes in its commercial ports". The primary purpose being to track long-term trends in the status of the aquatic environment in South African ports. (Section 2.7.2 examines the measurement of marine water quality at each port).

TNPA's vision includes a systematic improvement of the environment in which ports operate and have influence over. As a result, TNPA has a dedicated department looking at environmental issues that are managed through the implementation of an Environmental Management System (ISO 14001) standard. Consequently, the Transnet's Leadership have committed to finding sustainable innovative solutions. These commitments are embedded in the Transnet Safety, Health, Environment and Quality Risk Management Policy; which aims to minimise any possible negative impacts by proactively implementing pollution prevention measures within the TNPA operations (Gama, 2018).

1.2 Research Problem

In the Republic of South Africa, the Integrated Coastal Management is a familiar approach to the management of the coastal environment and its resources (DEA, 2014a). Drawing from world-wide trends for coastal management, South Africa acknowledged the need for a dedicated legislation that protects the marine environment and as a result, in 2009 the Integrated Coastal Management Act (ICM Act) was promulgated (RSA, 2008). Nevertheless, to date Authorities accountable for the execution of the ICM Act have to cope with the management

of a highly multifaceted environment that is exposed to natural and anthropogenic pressures (DEA, 2014a). Globe, van der Elst and Oellermann (2014) indicate that in order for the ICM Act initiatives to be effective, entities who utilise and manage the coastal environment need an improved management and understanding of the importance of coastal resources complexities. Furthermore, Crowder et al., (2006, p.617) state that "management administrations for individual sectors operate under different legal mandates and reflect the interests of different stakeholders, so governance is perforated with gaps and overlaps".

Additionally, Chevallier (2017) indicate that the diverse coastal and marine resources are exploited, these need a sustainable oceans economy for effective management tools that seeks to protect the livelihoods of the people, coastal and marine biodiversity resilience and to regulate sustainable resource use. Furthermore, integrated resource management, ecosystem based, coastal and marine spatial planning are approaches implemented to promote sustainable oceans (Chevallier, 2017). As previously indicated, TNPA operates within the domain of the National Ports Act, and is expected to perform its functions in a fair and reasonable regularity to ensure that the establishment, development, maintenance and protection of the environment in the Ports is accomplished (TNPA, 2018; RSA, 2005). On the other hand, Globe, van der Elst and Oellermann (2014) indicate that worldwide, the policy makers' have recognized a need for sensible and effective management of the coastal environment and are continually updating policies and legislation that address challenges encountered by coastal zones.

Notably, section 85 of the Port Rules RSA (2009, p.34) stipulate that "All persons within a port must take all reasonable steps to prevent, minimise and mitigate pollution or damage to, or degradation of the environment". It further states that "any person who pollutes or causes damage to the environment will bear the costs associated with the combating and cleaning up of that pollution, damage or degradation, and the associated impacts relating thereto"

Sampling at ports is done twice a year during summer and winter seasons. However, there are incidences that occur in between the sampling events that are not adequately captured in the monitoring reports.

1.3 The overall objective of the study

The overall objective of this study is to examine current and proposed marine water quality management practices in South African seaports.

1.4 Objectives of the study

The following specific objectives have been identified for the study.

- To examine the current marine water quality management practices in South African seaports.
- To examine the contributing factors to marine water quality in South African seaports.
- To examine the current and proposed marine water pollution prevention strategies in South African seaports.

1.5 Research Questions

- What is the current practice of the marine water quality management in South African seaports?
- What are the contributing factors to marine water quality in South African seaports?
- What are the present and proposed marine water pollution prevention strategies?

1.6 Significance of the study

The South African seaports are the country's asset and facilitate international maritime interests. The Port Authority has a duty to manage, protect and enhance sustainable development and economic functioning of the ports. Havenga et al., (2016) indicate that through this mandate the ports should eventually be able to contribute to the state strategic objectives of economic growth, amplified investment, poverty alleviation and employment formation.

1.7 Research Methodology

A literature review was conducted using information obtained from books, journals and electronic sources. The literature review provides a clear background for the study and what actions have been undertaken towards the management of marine water quality issues. The review took into consideration the standards, regulations and legislation that exist internationally and locally.

Primary data was obtain by interviewing the following participants: eight environmental management personnel and two Harbour Masters from TNPA, two marine water quality subject experts from the Council for Scientific and Industrial Research (CSIR), and two representatives

from the South African Maritime Authority (SAMSA). The study used purposive sampling to identify participants for the study.

Participants were interviewed face to face and telephonically dependent on their geographic location. All interviews were audio recorded, transcribed and analysed in a qualitative thematic manner, where patterns and themes were observed reflecting the marine water quality management practices in South African seaports. Participants were given an opportunity to review the baseline questions prior the telephonic or face to face interview, this was done to test the relevance of the questionnaire. For telephonic interviews informed consent forms were signed and emailed on the day of the interview and the consent forms were signed and scanned back to the interviewer prior the interview. Supplementary questions were asked based on the discussions, and this allowed the interviewer to saturate the discussion points.

1.8 Limitations of the study

The researcher of this study is currently employed as an Environment Manager in the Port of Durban. The researcher was excluded as a participant in the interview process. The shortfall was however compensated for by interviewing an environmental specialist exercising an oversight role on marine water quality management in the port. Another noticeable limitation is the fact that currently not all ports have environmental managers, and relevant personnel within the field were identified and interviewed accordingly. Notably, the study methodology targeted a group of participants based on a purposive sampling technique to contribute to the study, whereas, the institutional structures of marine water quality and coastal management are very comprehensive, leaving room for further studies to interview these additional institutions, such as DEA, DAFF, DoT, SANBI and many more. More importantly, further studies should include the marine fishing industry as participants to gauge their perspectives on marine water quality management. Also, future studies could be more quantitative in order to statistically quantify the marine water quality impact on the port environment.

1.9 Outline of the dissertation

The study has tailed a standard framework, and is set out as follows.

- Chapter one provides an overview to the study, demonstrating insight into the motivation for the study, the research questions and objective, the research methodology applied and the limitations and delimitations of the study.

- Chapter two comprises the literature review which pursues to examine marine water quality management practices in the ports system, coastal management framework, legal obligations and management programmes.
- Chapter three deliberates the investigation methodology used in the study, and clarifies the explanations for the choice of the methodology.
- Chapter four presents the data analyses
- Chapter five discussion.
- Chapter six discusses conclusions and recommendations.

1.10 Conclusion

This chapter pursued to provide a comprehensive overview of the study objective, which was to examine current and proposed marine water quality management practices in South Africa's commercial seaports. The chapter continued to provide background, motivation and focus of the study. The research problem was analysed, followed by the study objectives, research questions as well as significance of the study. Lastly, looked at the research methodology in terms of how primary and secondary data was obtained and the limitations of the study. The succeeding chapter is a literature review on marine water quality management intended at providing a comprehensive understanding of marine water quality, coastal management framework and the South African institutional mandate.

CHAPTER TWO
MARINE WATER QUALITY AND COASTAL MANAGEMENT FRAMEWORK

2.1 Introduction

Coastal environments are wealthy assets that provide direct and indirect opportunities in economic and social aspects (DEA, 2014). Mandela (1998, P. 1) state that "Africa's long and beautiful coasts and the abundance of marine resources can contribute to providing economic, food and environmental security for the continent. These coastal and marine resources, like the rest of Africa's environmental resources, cannot continue to be exploited in a manner that does not benefit Africa and her people. This is a paradox of a people dying from hunger, starvation and poverty when they are potentially so rich and well endowed". Legislative frameworks and management programmes that seek to promote coastal environment conservation and uphold its natural landscapes are of outmost importance for the promotion of sustainable use. Therefore, the purpose of this chapter is to conduct a literature review of obtainable local and international literature relating to marine water quality management. The chapter seeks to provide an overview of South Africa's coastal environment, roles and responsibilities of the government and other co-operative governance structures, legislative framework for integrated coastal management within the seaport system and provide an understanding of marine water quality management and international conventions that South Africa is signatory to. Furthermore, it discusses environmental challenges relating to marine water quality and what actions have been taken towards the protection and management of water quality. Section 2.2 looks at an international perspective on marine water quality. Section 2.3 gives an insight on South Africa's seaport institutional framework and commercial activities. Section 2.4 discusses the marine environment. Section 2.4 provides an understanding on South Africa's institutional mandate. Section 2.6 discusses governance approaches on marine water quality management. Section 2.7 examines marine water quality measurements and analysis. Section 2.8 looks at marine water quality management programmes. Section 2.9 draws some concluding remarks on marine water quality and coastal management framework.

2.2 International perspective

South Africa is countersigner to the International Maritime Organisation (IMO) and as such, the country is expected to implement relevant programmes that will ensure compliance and successful execution.

2.2.1 The International Maritime Organisation

According to IISS (2013) the maritime shipping industry, similar to other industries, is integrating sustainable practices into its processes that lessen costs and impacts on the environment, while strengthening its economic position and improving its social responsibility. The maritime environment is governed by a number of legislation and international conventions. At an intercontinental level, numerous legal instruments and controls have been provided to encourage regulations enforcement by flag states, coastal state and port state (Onwuegbuchunam et al., 2017). MARPOL 73/78 Annexes I, II, III, IV, V and VI has identified the sources of pollution and port states are obligated to have Port Waste Management Plans that serve as a guide for ship waste management and these plans are to be readily available upon request. The IMO convention on Marine Pollution MARPOL 73/78 outlines regulations aimed at inhibiting pollution from deliberate activities, pollution from routine vessel operations and accidental discharges into seas. Table 2.1 give an overview of the MARPOL six technical annexes that are responsible for addressing ship sourced pollution (IMO, 2019).

Table 2.1 Summary of the MARPOL six technical annexes

Annex I	Regulations for the prevention of pollution by oil
Annex II	Regulations for the control of pollution by noxious liquid substances in bulk
Annex III	Regulations for the prevention of pollution by harmful substances carried by sea in packaged form
Annex IV	Regulations for the prevention of pollution by sewage from ships
Annex V	Regulations for the prevention of pollution by garbage from ships
Annex VI	Regulations for the prevention of air pollution from ships

Source: Author compiled information from IMO, 2019a.

Table 2.2: Summary of the twelve IMO conventions that deal with ship-source marine pollution

International Convention Relating to Intervention on High seas in Cases of Oil Pollution Casualties (Interventions), 1969
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Dumping), 1972; Protocol of 1996
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)
International Convention on Salvage (Salvage), 1989
International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS), 1996; HNS Protocol 2010
International Convention on Oil Pollution Preparedness, response and Cooperation (OPRC), 1990; HNS Protocol (OPRC-HNS Protocol), 2000
International Convention on Civil Liability for Oil Pollution damage (CLC), 1992
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND), 1992; Supplementary Fund Protocol, 2003 International Convention on Civil Liability for Bunker Oil Pollution Damage (Bunkers), 2001
International Convention for the Control and Management of Ships' Ballast Water and Sediment (BWM), 2004
The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (SRC), 2009

Source: Author compiled information from Mukherjee and Bal (2011, p. 7)

The International Convention to Intervention on High Seas in cases of Oil Pollution Causalities was accepted following upon a maritime casualty to sustain the right of coastal state to take necessary measures to prevent, mitigate, or eliminate danger or pollution to coastline (IMO, 2019b). Mukherjee and Bal (2011, p. 6) indicate that "almost all international convention tools governing ship-source marine pollution are IMO conventions". Furthermore, Mukherjee and Bal (2011, p. 6) indicate that "marine pollution can be characterized as ship and non-ship source pollution impacting on the marine environment". Ship source marine pollution may be a voluntary activity or it can be caused accidentally through oil spills. Mukherjee and Bal (2011, p. 5) state that "where a ship source pollutant enters the sea from a voluntary act it may occur through the deliberate dumping of pollutants referred to as wastes in the relevant conventions,

and also discharges incidental to the normal operations of a ship". These conventions on Ship-source and non-ship source marine pollution, are further depicted in figure 2.1 for ease of understanding.

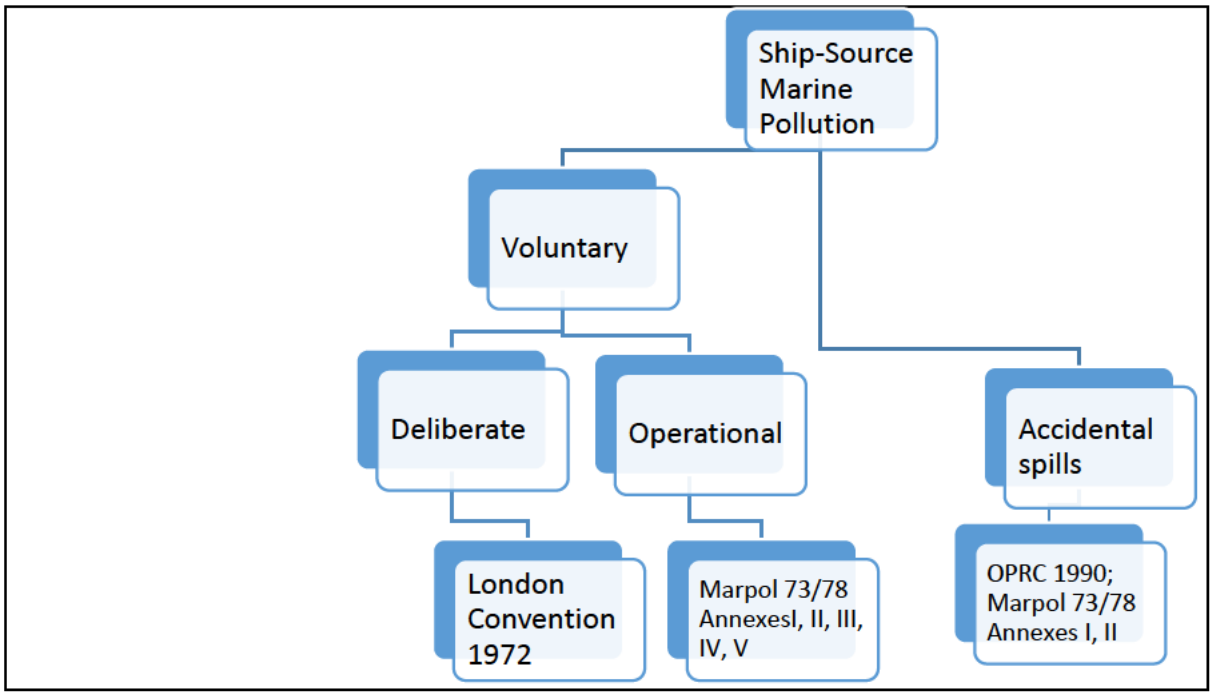

Figure 2.1 International Conventions governing Ship-source Marine Pollution.

Source: Mukherjee and Bal, 2011, p.6

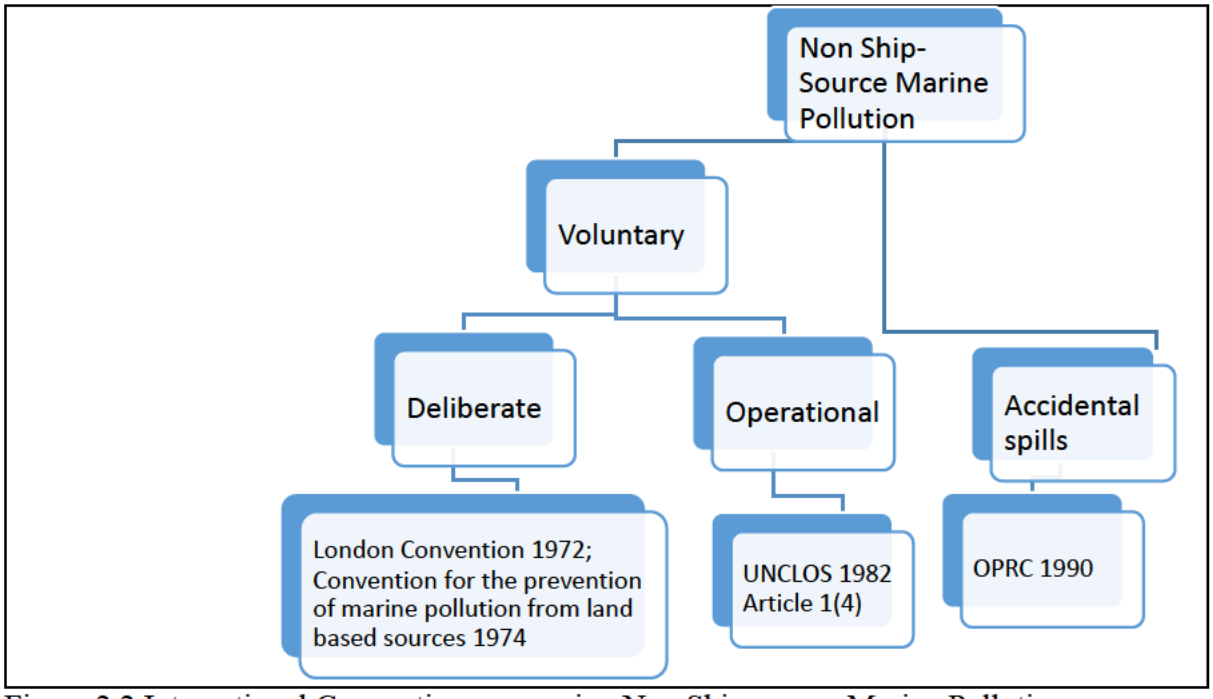

Figure 2.2 International Conventions governing Non Ship-source Marine Pollution.

Source: Mukherjee and Bal, 2011, p.6

The 1982 United Nations Convention on the Law of the Seas (UNCLOS) Article 1 (4) defines pollution of the marine environment as a direct or indirect introduction of substances by man that is likely to result in a negative impact on marine living resources, quality of seawater and in the reduction of marine amenities. In response to the management of water and sediment and control of foreign objects, the International Convention for Control and Management of Ships' Ballast Water and Sediment was adopted in 2004 and came into force in September 2017; and aims "to prevent the control and the spread of marine invasive species from state to state through the establishment and implementation of ships' ballast water and sediment control procedures" (UNCLOS, 1994). RSA (2005, p. 62) indicate that the National Ports Act, chapter 7 Section 69 (1) makes provision for the protection of environment by stating that "the Authority must in the performance of its functions ensure that a fair and reasonable balance is achieved between the protection of the environment and the establishment, development and maintenance of ports".

Notably, IMO (2019b, p. 1) indicate that "the International Maritime Dangerous Goods (IMDG) code adopted in 1965 as per safety for Life at Sea (SOLAS) convention of 1960 under the IMO". The IMDG Code was formed to prevent all types of pollution at sea. The IMDG code's requirements apply to all ships that are subject to the SOLAS and MARPOL conventions. The SOLAS covers the safety implications of dangerous goods on board ships whereas MARPOL covers the pollution aspects for ships carrying dangerous goods. The IMO has developed a number of conventions that govern the maritime industry, and some of these conventions are summarised underneath.

2.2.2 The London Convention and Protocol

The London Convention contributes to the international control and prevention of marine pollution, and aim at preventing unselective disposal of waste at sea which is liable to create hazards to human health, marine life, and living resources (IMO, 2019a). Furthermore, this convention forbids the dumping of hazardous materials at sea, however, provisions are made upon issuing of a special dumping permit. Section 88 of the Port Rules (RSA, 2009, p. 36) state that "the master of a vessel and any other person to whom the Port Ballast Waste Management Plan applies, must comply with the plan".

2.2.3 Nairobi Convention

The Nairobi Convention for the protection, management and development of coastal and marine environment is working towards flourishing the Western Indian Ocean Region with

healthy rivers, coasts and oceans in partnership with governments, civil society and the private sector. The Convention entered into force in 1996 and is part of the UNEP's Regional Seas Programme (UNEP, 2018). UNEP (2018, p.1) state that the Conventions aims "at addressing the dilapidation of the world's ocean and coastal areas through the sustainable management use of the marine and coastal environment". According to Walker (2018) the Southern African Development Community (SADC) maritime strategy needs to be lengthened into an integrated strategy for the whole SADC region to emulate Regional Economic Communities (REC's) such as the Economic Community of West African States (ECOWAS).

2.3.4 Benguela Current Convention

According to GEF (2019, p.1) the Benguela Current Convention (BCC) "was established in 2007 with a mandate of restoring, maintaining and conserving the biological integrity of the Bunguela Current Large Marine Ecosystem" (BCLME); with the strategic emphasis on "biodiversity and ecosystem health, environmental monitoring, mitigation of pollution and minimising the impacts of marine diamond mining and oil and gas production". Moreover, it is a multilateral organisation that encourages sustainable and optimal usage of the BCLME and is shared by South Africa, Namibia and Angola. The BCLME is branded worldwide as an asset of global importance with the greatest marine productive ecosystem (GEF, 2019). DEA (2019) reported that Namibia and South Africa have signed a Memorandum of Understanding (MoU) outlining the working approach in relation to the co-management of the fisheries space as is a critical component. Furthermore, the MoU seeks cooperation in areas of research and development through a joint specialised working group for the evaluation, socio-economic and management study of mutual marine resources. The joint working group will pursue methodologies in safeguarding and reducing the matters of illegal and unregulated fishing within the BCLME (DEA, 2019).

DEA (2019) indicate that the BCC countries have implemented demonstration projects with diverse focus. South Africa projects about examining the causes and impacts on living marine resources and associated dependent communities due to impaired water quality with the aim of improving national standards and guidelines, and most importantly to improve commercial and industrial institutions with respect to environmental practices . The pilot project site was chosen based on a number of commercial activities.

2.2.5 Convention on Biological Diversity

The Convention on Biological Diversity (CBD) is an international treaty intended for preservation and sustainable usage of biological diversity and it has managed to bring together various stakeholders at international levels to address the issues of rapid biodiversity loss (Chandra & Idrisova, 2011). However, research conducted by Chandra and Idrisova (2011) further indicate that challenges in financial, political, sectoral and institutional sectors remain a concern when it comes to decision making.

2.2.6 Global Environment Facility

The world's largest environmental funding organisation, Global Environment Facility (GEF) was established as a multidimensional financial mechanism in 1991 to test new methodologies and innovative ways of responding to over-all environmental challenges. Biodiversity, climate change, international waters, land degradation, the ozone layer and persistent organic pollutants are the six GEF's areas of focus (UNEP, 2018). It is also important to mention that, GEF "assist developing countries to meet the objectives of the United Nations international environmental conventions such as, the United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention to Combat Desertification (UNCCD), Convention on Biological Diversity (CBD) and The Stockholm Convention on Persistant Organic Pollutants" though funding initiatives (GEF, 2019).

2.2.7 Intergovernmental Oceanographic Commission

Under the auspices of The United Nations Educational, Scientific and Cultural Organization (UNESCO), in the 1960s the Intergovernmental Oceanographic Commission (IOC) began its mission to manage and promote activities and programmes in ocean science, ocean observation and lessening of marine vulnerabilities (UNESCO, 2017). The IOC aims to coordinate and promote international cooperation in the "marine research, services, observation system, hazard mitigation, and capacity development programmes in order to comprehend and efficiently manage the resources of the ocean and coastal areas" (UNESCO, 2017, p. 1). With respect to the coordinated programmes in developing countries, the commission desires to improve the governance, management, institutional capacity, and decision-making processes of its Member States with respect to the marine environment. In addition, the IOC through the Global Ocean Observation System (GOOS) manages "ocean observation and monitoring which aims to develop a cohesive network providing information and data exchange on the physical, chemical, and biological aspects of the ocean; that the scientists, industry, governments and the

public could use to action on marine concerns" (UNESCO, 2017, p.1). The IOC focuses on the most harmful impacts, such as "ocean acidification, temperature increase, sea-level rise, deoxygenation, and changes in marine biodiversity". The IOC pursued to reinforce the climate administration by establishing a worldwide education on the role of the ocean in the climate system by participating in the COP21 (UNESCO, 2017).

2.2.8 Ocean Observations and Services

UNESCO (2017, p.1) state that "Ocean Observations and Services (OOS) in partnership with various international organizations to implement global scale sustained ocean observations and deliver the products and services that ensure the livelihood and ecosystems". Knowledge of scientific nature acquired through sustained ocean observations are applied through early warning systems for ocean related hazards, climate forecasts and projections, ecosystem management and assessments and ocean governance (UNESCO, 2017).

2.2.9 OceanObs'09

In September 2009, the OceanObs'09 conference was held in Venice to discuss provisions of sustained global information on management of living marine resources (IOC/UNESCO, 2008). Busalacchi (2010) indicate that as much as there has been a call for action in relation to global climate services, there is also a need for sustained establishment of ocean facts and marine services resulting from marine variability forecasting. On the other hand, Doherty (2009) state that the move from innovative research driven by observations and applicable demonstrations to operational monitoring systems that are sustained is hindered by long term data continuity challenges. Doherty (2010) further explains that the major contributor to the global economy is the marine sector. Pouliquen (2010) state that impressive amount of ocean data exists through routine monitoring and can be used as a predicting tool for ocean health.

Remarkably, in September 2017, the author of this dissertation participated in an exchange programme for Strategic and Economic Priorities for the Indian Ocean Region offered by the US Consulate. The programme was designed for maritime officials, trade and resource specialists who assess institutional arrangements to ensure maritime security and resolve maritime disputes. The team engaged in discussions that looked at strategies to expand port development, tourism, and other economic linkages throughout the region. The project also addressed ocean resource-related issues that limit regional connectivity such as over-fishing and marine pollution. This multi-regional programme examined bilateral and multi-country

strategies for addressing critical issues ranging from port and maritime security to increased demands on coastal and marine resources.

2.3 South Africa's institutional framework and commercial activities

DoT (2001) and Walker (2018) indicate that South Africa depend on its eight major commercial seaports for international trade. Transnet National Ports Authority (TNPA) was created under the auspices of The National Ports Act, No 12 of 2005 (RSA, 2005). TNPA has been entrusted by the Government of the Republic of South Africa to efficiently and effectively manage, control and administer the economic functioning of the national ports system as a landlord port. South Africa's coastline is measured at approximately 2,798 kilometres as indicated in Figure 2.1 (DEA, 2017; Transnet, 2018). Moreover, Figure 2.3 provides an overview of the TNPA governance reporting structure, whilst Table 2.3 provides the summary of the National Ports Act, No. 12 of 2005 primary objectives, and lastly Table 2.4 which gives an insight on the main commodities handled at South Africa's commercial seaports.

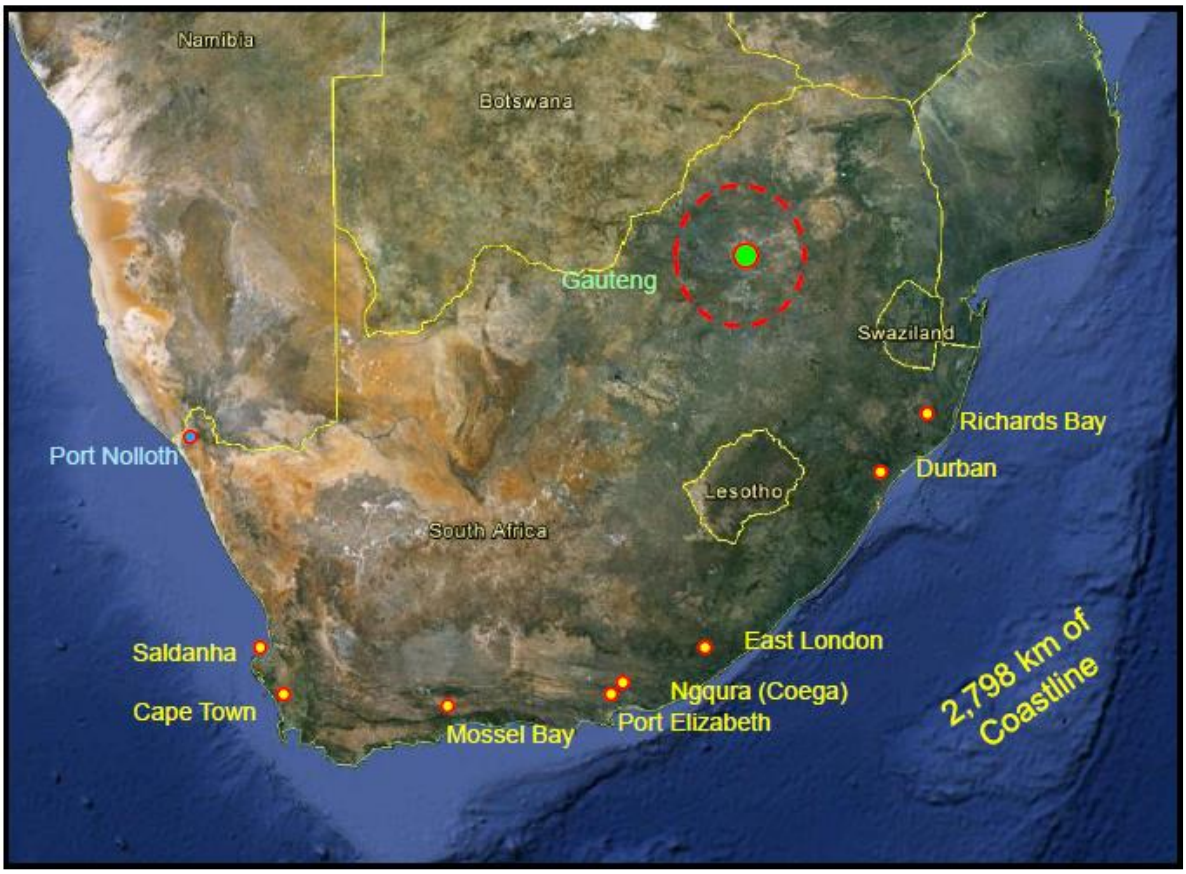

Figure 2.3. Geographic location of the South African Commercial Seaports
Source: DEA, 2017; TNPA, 2018

2.3.1 Transnet National Ports Authority Reporting Structure

Figure 2.4 illustrates the TNPA reporting and management governance structure.

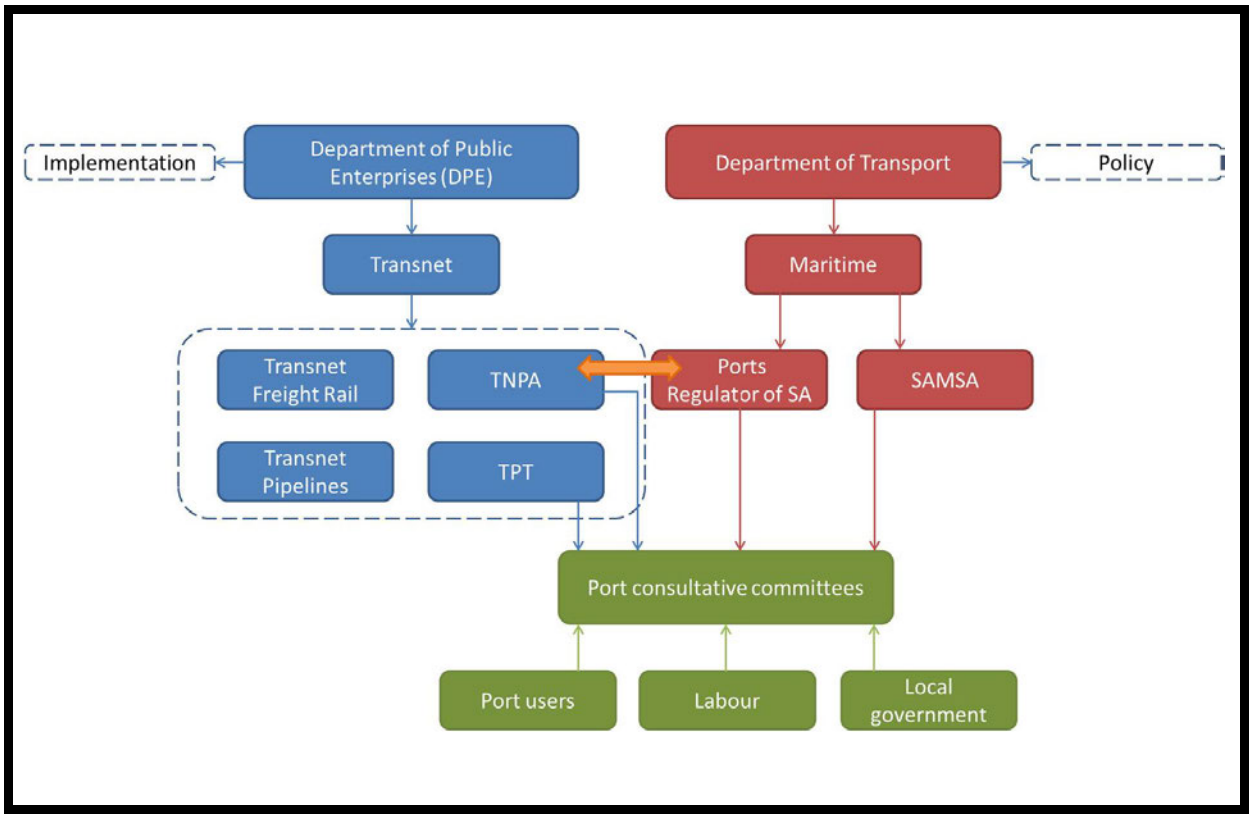

Figure 2.4. The TNPA reporting governance framework for South African seaports.

Source: Author adopted from Havenga et al., 2016, p. 4

Table 2.3 Summary of the National Ports Act, No. 12 of 2005 primary objectives

Objectives of the National Ports Act	"Promote the development of an effective and productive South African ports industry that is capable of contributing to the economic growth and development of the country"
	"Establish appropriate institutional arrangements to support the governance of ports"
	"Promote and improve efficiency and performance in the management and operation of ports"

	"Enhance transparency in the management of ports"
	"To promote the development of an integrated regional production and distribution system in support of government's policies"

Source: Author compiled information from National Ports Act (RSA, 2005, p. 7)

Table 2.4 Main commodities handled at South Africa's ports

Automotive	Durban, East London, Port Elizabeth
Containers	Durban, Cape Town, Ngqura, Port Elizabeth
Dry Bulk	Richards Bay (coal), Saldanha (iron ore), Port Elizabeth (manganese)
Liquid Bulk	Richards Bay, Durban, East London, Ngqura, Port Elizabeth, Mossel Bay, Cape Town, Saldanha
Break Bulk	Richards Bay, Durban, East London, Ngqura, Port Elizabeth, Mossel Bay, Cape Town, Saldanha

Source: Author compiled information from TNPA, 2013; Havenga et al., 2017

2.4 Marine Environment

The port environment globally is rapidly evolving and is exposed to opportunities and challenges. Seaports are designed to provide a secure environment for consignment handling and to promote intercontinental maritime trade; as well as provide for socio-economic aspects such as aquaculture, industrial usage, residential and tourism opportunities through the provisions of waterfront developments, pleasure crafts, local cruises and recreational fishing (CSIR, 2016; 2017). Whereas, Schipper et al., (2015) indicate that customarily, seaports are built mainly for local trade and are often characterised and surrounded by polluted industries, deficient transport systems and a lack of public health interest and with no consciousness for environmental concerns. According to DEA (2015) seaports are a home to marine fauna and flora and endure a comprehensive range of commercial, social and environmental functioning that are a basis for the livelihood of masses of South Africans.

At the same time their existence has adverse environmental impacts on water pollution through discharges from vessels due to the nature of operations (Hens & Stoyanov, 2011).
In the early parts of the 20th century, ports were characterised by poor water quality and air pollution due to local industrial activities; as a result, industrial and port activities in general created a negative impact on the marine ecosystem due to the nature of the operations (Schipper et al., 2015). Research conducted by Darbra et al., (2005) also indicate that from an environmental perspective, seaports can be a cradle of multidimensional systems with environmental concerns ranging from releases of air, water and soil pollution, waste production, oil pollution and dredging activities just to mention a few. DEA (2012, p. 7) also indicate that "the key pressure on marine ecosystems is fishing followed by secondary pressures such as, but not limited to, shipping, invasive alien species, mining, waste water discharge particularly around cities and coastal settlements and reduction of fresh water inflow to the marine and coastal environment from rivers". Hovey et al., (2015) explain that poor water quality is one of the main concerns in the marine environment due to its effect on a wide range of environmental standards. According to Lee and Jones-Lee (2003) ports and harbour Authorities are antagonised with challenges of pollutants from port activities. On the other hand, CSIR (2017) indicate that long term sustainability of seaport activities requires an ecologically sustainable port marine environment that can be achieved through good water and sediment quality management.

Recently, there has been a growing interest in the environmental impact of port development and operations, largely due to pressing global ecological issues (CSIR, 2013). The ports system has therefore become subjected to inquiry in terms of environmental regulatory compliance (TNPA, 2013). The focus on environmental issues is especially felt in the port operations value chain, port development projects and hinterland accessibility (TNPA, 2013). On the other hand, it remains essential to afford adequate capability, quality service and cost effective solutions (Havenga et al., 2016). In order to balance these competing needs, it has become imperative for the port authorities to manage port operations in a holistic and sustainable manner (TNPA, 2013). To ensure regulatory compliance, the port authority subscribes to international environmental management standards ISO 14001(Edwards, 2001).

The purpose of implementing the ISO 14001 framework is for the ports to manage the aspects and impacts of its operations. The aspects of environmental quality, economic affluence and social responsibility in the Environment Management System (EMS) is of utmost importance

as it emphasises on usage and management of resources for the present whilst uncompromising the needs of the future generations. The EMS framework incorporates environmental considerations and decision making into ports daily operations, strategic planning and provide for a structured evaluation and monitoring approach (RSA, 1996).

2.4.1 Value of the South Africa's Coastal Environment

South Africa's shoreline is a varied and rich asset of nationwide interests due to its immense opportunities for humanity in relation to mining, trade, agriculture, tourism and fisheries (DEA, 2014a). The Constitution of the Republic of South Africa states that South Africans are "responsible for preserving the integrity of the coast for present and future generations" (SA, 1996, p. 9; DEA, 2012). Managing the improvement and justifiable use of marine and coastal resources in South Africa is an overwhelming responsibility that requires a combination of agility, understanding and a foundation of a regulatory structure for the management, safeguard and preservation of marine coastal resources (DEAT, 2008). Driver et al., (2012) indicate that marine and coastal goods and services are amongst the greatest contributors to human wellbeing. In 1994 the estimated global value of these goods and services was close to US$ 21 trillion. In South Africa, coastal goods and services was estimated at US$11 billion in 2009 which was equivalent to 3.6% of the country's Gross Domestic product (GDP). Moreover, Driver et al., (2012) indicate that the fishing commerce in South Africa is exclusively dependent on marine goods and services and it is a significant contribution to the economy. South Africa has a well-established environmental legislative framework, and has potential to achieve environmentally sustainable practices through its overarching Environmental Management Act (SA, 1998). Moreover, the country has a rich heritage of coastal and ocean ecosystems (SANBI, 2019).

2.4.2 Functions of coastal marine ecosystems

Oceans are important to the development and sustainability of livelihoods (Costanza et al., 1998). The NDP (2011, p. 90) states that "failures in the market and policies have caused, in the global economy, an era of environmental scarcity as natural resources such as marine life, terrestrial biodiversity, are degrading quicker than they can be replenished". DEA (2015) support the NDP statement by affirming that marine ecosystems goods and services are of critical importance as they openly and ultimately impact on the supply of food security, agriculture, human livelihoods and trade and industry. It has been noted that marine health status is deteriorating, the reason being that marine ecosystem stressors such as pollution,

overfishing, invasive species, climate change and coastal development are impacting negatively on the capability of oceans and coastal ecosystems to support and withstand the goods and services (Foley et al., 2010). Taljaard and Nierkerk (2012) indicate that oceans capacity to provide food, good water quality and the ability to recover from pressures is gradually impaired by the loss of marine biodiversity. The Taljaard and Nierkerk statement is corroborated by Foley et al., (2010) where they state that the uncoordinated expansion of current norms of the marine environment and other emerging uses such as aquaculture, renewable energy and coastal human population are likely to negatively contribute towards the decline of the ecological health status. Maintaining the well-being of the marine ecosystems around the world as well as their ability to provide essential goods and services requires a sound governance framework coordinated by both interested and affected stakeholders. The Department of Environment Affairs (DEA) strategic plan mandate is "to play a key role in aquatic protection services and ocean governance, which entails the protection of the marine environment from illegal activities whilst promoting its multiple socio-economic benefits" (DEA, 2015, p. 9).

According to DEA (2014a) environmental conditions shape the diverse coastal ecosystems around the world and these conditions set the boundaries for ecosystem functioning and development. In turn, balanced shoreline ecosystems provide a number of goods and services such as water quality, food production, biodiversity, shoreline stabilisation and climate change regulation.

South Africa as an emerging country needs to continuously stabilise the economic prospects which the oceans and coast affords the country, at the same time preserve its environmental integrity (DEA, 2014). In a mission to manage the South African coast, the Government enacted the National Environment Management: Integrated Coastal Management Act that came into force on 1 December 2009 with the drive of establishing a system of integrated coastal and estuarine management for the promotion of coastal environment conservation (Ameersingh, 2016). Lindenmayer and Liken (2010) state that given the growing concern of environmental challenges globally, a need for the establishment of an effective monitoring and management system is critical to provide for sustainable marine improvement and development.

In pursuit of sustainable practices, the Government of the republic of South Africa announced in October 2018 a system of twenty (20) new Marine Protected Areas (MPAs) declared under the auspices of the National Environmental Management: Protected Areas Act (RSA, 2003). This initiative improved South Africa's ocean protection from 0.4% to 5% of its ocean (SANBI, 2019). Furthermore, for the country to meet its sustainability Goals of the United Nations and Ocean Economy objectives, is expected by 2020 to have an additional 5% of its oceans protected in order to reach the set 10% target. Accordingly to SANBI (2019) the recently protected areas will improve ocean protection by approximately 50 000km an area two and half the size of the renowned Kruger National Park. South Africa's effort to protect ocean heritage for current and future usage will considerably be advanced by this addition of the MPA's; as it will contribute towards fisheries sustainability, marine ecotourism, and support ecosystem resilience that is climate change pressured. Notably, UNESCO (2015) also indicate that improving ocean resilience to climate change and biodiversity conservation can be achieved by growing the number and magnitude of Marine Protected Areas.

2.4.3 Coastal Ecosystems Health Status

DEA (2014a, p. 47) indicate that the ecosystem threat status of 136 marine and coastal habitat types was assessed which was categorized as follows: "58 coastal, 62 offshore benthic and 16 offshore pelagic habitat types grouped into a total of 14 broad ecosystem groups. A total of 64 habitat types are measured endangered at 47%. Of these habitat types 17% are critically endangered, 7% endangered, 23% vulnerable and least threatened at 52%".

2.4.4 Oceans Economy

In October 2014, in an expedition to unlock the prospects of South Africa's oceans and coastal environment and its contribution to the country's economy, President Jacob Zuma launched the Operation Phakisa programme (Walker, 2018). DEA (2015, p. 9) indicate that "South Africa's oceans have a potential to contribute more than R20 billion to the Gross Domestic Product (GDP) by 2019 and create at least one (1) million job opportunities by 2023". As previously indicated, DEA has a role to play in ocean governance and in the fortification of the South African ocean from unlawful activities while stimulating socio-economic benefits through the realization of the ocean economy famously known as "Operation Phakisa".

DEA (2016b, p. 1) indicate that in partnership "with the South African Maritime Authority (SAMSA), the Nelson Mandela Metropolitan University (NMMU), the South African

International Maritime Institute (SAIMI) and the Norwegian Embassy in Pretoria, the Oceans Economy Secretariat, under the Department of Environmental Affairs", hosted an operation Phakisa seminar titled "Oceans Economy- Exploring Opportunities: Towards A National Maritime Cluster" The 2016 June seminar was designed with the objective of bringing together relevant stakeholders, multi-institutions and specialists to open a platform for knowledge exchange, incite strategic dialogues, and explore innovations that will potentially create a South African Maritime Industries Cluster (DEA, 2016b). Particularly, the Operation Phakisa expedition considered various streams that had a potential to unlock economic, social and environmental opportunities. Undoubtedly, the Marine Protection Services and Ocean Governance stream was a necessity for South Africa's jurisdiction in relation to exclusive economic zone, which extends to approximately half a million square kilometres. As a result, the ocean governance undertook to develop an Integrated Ocean Governance Framework and to deliver a National Marine Spatial Planning Framework for the enablement of an ocean economy that is sustainable (DPME, 2019). Notably, Morris et al., (2017) indicate that the science community of South Africa in partnership with government organizations has recently established a comprehensive observational network for monitoring and measuring the Greater Agulhas Current System and its inter-ocean exchanges in order to comprehend changes in the ocean space.

2.4.5 South Africa's Coastal Management Mandate

Government has an obligation to protect the marine environment for the benefit of generational usage. The country's programmes for the maritime sector over the years were mainly in favour of industrial development, and marine environmental protection has largely been unheeded. Hitherto, the triple bottom line calls for economic, social and environmental balancing act (DoT, 2017; SAMSA, 2015). According to DoT (2017) the mandate and obligations to develop policies and take conforming measures for the safeguard of the aquatic environment emanate from numerous international, continental and regional policy declarations. South Africa is party to various political declarations, including the 1992 Rio Declaration on Environment and Development and its Agenda 21, the Millennium Declaration and the Millennium Development Goals, 2000, as well as the Rio+20 Declaration (DoT, 2017). Moreover, several pieces of environmental legislation and policies at national level have a bearing in the maritime transport industry or policy, including the Constitution of the Republic of South Africa, the National Environment Management Act, and the White paper on National Climate Change Response. Through the Department of Transport, South Africa is a signatory to numerous of these

agreements, with corresponding rights and obligations. Notably, the country needs to formulate and implement policies related to its multilateral obligations regarding the protection of its marine environment, while also giving effect to national environmental legislation.

DEA (2015, p. 11) indicate that "the protection of the environment and ecosystems on which livelihoods depend has emerged as one of the most pressing issues in the past few decades". Apprehensive with the repercussions of unstainable intake of limited natural resources, through the United Nations system, governments decided to launch multilateral environmental agreements with one common vision, which is the safeguard of the environment for the use of present and future generations. The methodology adopted by the Governments toward protection of the marine environment from pollution is equally reactive and proactive. DoT (2017, p. 72) state that the reactive element is the mandate of the DEA, it deals with mitigating and combating the effects of pollution from ships once it has occurred; whereas the proactive is the SAMSA accountability that lies in "pollution prevention from ships". In accordance with S92 of the Port Rules for the Harbours of South Africa (RSA, 2009) Ports are obligated to provide adequate environmental infrastructure and systems, such as reception facilities; for example, reception facilities assist to alleviate illegal dumping at sea from ship-sourced pollutants.

Coastal environments are inherently interconnected with society and provide humanity with countless economic, ecological and social benefits, ranging from regulating the weather to providing oxygen and food to the universal population. However, overexploitation of the marine environment and other human activities, have over the years had an adverse impact on the marine environment. As a result, operational strategies that will protect the marine environment for the benefit of current and future use need to be explored (DEA, 2014c).

DoT (2017) state that, undoubtedly, the maritime industry has always been prone to environmental issues, such as, oil pollution, ballast water discharges and the spread of aquatic invasive species. In addition to the highlighted concerns, latest developments in global warming and climate change have advanced the emphasis on the need to control matters of pollution caused by the discharge of oil, liquid and sewerage, other harmful substances and garbage from routine shipping operations (DoT, 2017). UNESCO (2017) indicate that crucial to sustainable marine resource use are improvements in monitoring threats to the ocean and reduction of additional cumulative effects from pollution and shipping. Importantly, as South

Africa is party to the IMO, it is expected to abide by the IMO regulations, and initiate the necessary plans to ensure compliance and successful implementation. To give effect to coastal management, the following section looks at the roles and responsibilities of various institutions.

2.5 South African Institutional Mandate

As previously indicated, the South African coastline stretches for approximately 2,798 kilometres across provinces, namely KwaZulu-Natal, Eastern Cape, Western Cape and the Northern Cape (DEA, 2017). It sustains livelihoods and supports many human activities, which in turn affect the wellbeing of the coast. The land and sea below the high water mark cannot be privately owned, thus the coast should be freely accessible to all South Africans (DEA, 2017). DEA (2017, p.3) indicate that it is therefore important to note that "the coast is shared by multiple users and beneficiaries for recreational use, seafood processing, aquaculture, fishing, shipping, desalination and conservation". However, DEA (2017, p.3) indicate that these consumers and beneficiaries of the same space may impact on each other's Constitutional rights, it is therefore imperative that these spaces be managed in the interest of the public". Furthermore, Crowder et al., (2006, p.617) state that "Problems in ocean resource management derive from governance, not science. Ocean zoning would replace a mismatched and fragmented approach with integrated regulatory domains". Therefore, the below government structures play a significant role in the management of the marine and coastal environment (DEA, 2015; 2016).

2.5.1 Department of Environmental Affairs

The directive of the Department of Environmental Affairs (DEA) is to safeguard environmental protection and natural resource conservation, furthermore to ensure sustainable development and equitable utilization and distribution of benefits acquired from the natural environment.

In realizing the abovementioned mandate, DEA is directed by the Constitution of the Republic of South Africa, Section 24, to formulate, coordinate, monitor and implement national policies, programmes and legislation (DEA, 2015). DEA (2015, p. 21; 2016) state that through its 2015/16 to 2019/20 strategic plan aims to "provide governance in environmental management, conservation, utilization and protection of ecological infrastructure". In particular, the department administers environmental authorizations and issues coastal waters discharge permits (DAFF, 2013). DEA also plays a vital role in contributing towards South Africa's commercial success through accelerating development in numerous environment interrelated sectors inclusive of ocean economy.

2.5.2 Department of Public Enterprise

The Department of Public Enterprise (DPE) is mandated to drive investment, productivity and transformation of SOCs, its customer base as well as suppliers, with the aim of facilitating growth, industrialization, job creation and skills development (DPE, 2014). Transnet State-Owned Company (SOC) is one of ten state-owned enterprises that fall under the Department of Public Enterprise.

2.5.3 Department of Transport

The Department of Transport's (DoT) mission is to be at the forefront of an integrated efficient transport system which the department aims to achieve by developing sustainable policies, regulations and feasible models to facilitate government strategies for social, economic and international development (DoT, 2017).

2.5.4 Ports Regulator of South Africa

The Ports Regulator of South Africa was established in accordance with the National Ports Act No. 12 of 2005. RSA (2005, p. 33) indicate that "the Regulator is a key component of the ports regulatory design envisaged in the National Commercial Ports Policy". In the South African ports system the Regulator's key function is economic regulations, in line with the government strategic economic development (RSA, 2005). Furthermore, the Ports Regulator is mandated to regulate pricing and other aspects of economic regulation, promote equitable access to ports services and facilities as well as monitoring the ports industry's regulatory framework compliance.

2.5.5 Department of Water and Sanitation

The Department of Water Affairs (DWS) is mandated with protecting South Africa's water resources through policy formulation and implementation. DWS encourages sustainable, effective and efficient water resource management thus ensuring sustainable social and economic development and protection of the natural environment (DWS, 2019).

2.5.6 South African National Biodiversity Institute

The South African National Biodiversity Institute (SANBI) is at the forefront of biodiversity research, monitoring and reporting in South Africa. SANBI avails knowledge and information to stakeholders such as Transnet SOC to ensure that planning and policy implementation is undertaken utilizing the best-practice management models and in an environmentally

sustainable manner. Furthermore, the institute restores, rehabilitates and facilitates the development of human capital, and manages natural resources for the benefit of present and future generations (SANBI, 2019).

2.5.7 South African Heritage Resources Agency

South Africa Heritage Resources Agency (SAHRA) is a legal agency established under the National Heritage Resources Act, Act No. 25 of 1999 to administer "the protection of South Africa's cultural heritage for the benefit of present and future generations". SAHRA attempts to involve the community and other relevant stakeholders in the management of heritage resources through education and training (SAHRA, 2019).

2.5.8 Department of Agriculture, Forestry and Fisheries

The Department of Agriculture, Forestry and Fisheries (DAFF) is mandated to accomplish the development and justifiable use of marine and coastal resources whilst maximizing the economic potential of the fishing industry. The department is also tasked with protecting quality and integrity of the country's marine and coastal ecosystems. Furthermore, DAFF (2013, p. 15) indicate that "DAFF is responsible for ensuring access to sufficient, safe and nutritious food by the country's population".

2.5.9 South African Maritime Safety Authority

South African Maritime Safety Authority (SAMSA) aims to ensure maritime safety, health and environmental protection thus stimulating South Africa's maritime industry. SAMSA plays an active role in the development and implementation of environmental protection standards, technical and operating standards, response to marine pollution, and maritime emergencies, amongst other things (SAMSA, 2015).

2.5.10 South African Waste Information Centre

The South Africa Waste Information Centre (SAWIC) was established by DEA in 2005. It is a data capturing system utilized by industry and government to monitor tonnages of waste generated, recycled and disposed of in South Africa on a monthly and annual basis (SAWIC, 2019).

2.5.11 South African Weather Services

In an effort to assist coastal and offshore ocean users, disaster management, municipalities and city councils to access real time in case of an emergency and provide for a forecast model for conditions such as storm surges and high waves; the South African Weather Services (SAWS) has since launched a marine portal website (SAWS, 2019).

2.6 Governance approaches on marine water quality management

Governance is an institutional structure that is concerned with management approach for planning and decision making (DEA, 2014). As such, TNPA has an institutional mandate as the custodian of South African seaports "to regulate and control pollution and protection of the environment within its limits" (RSA, 2005, p. 14), in fulfilling the mandate TNPA is cognisant of the legislative framework.

2.6.1 South African Legal Framework and Other Requirements

This section provides all the key environmental laws and regulations that apply to the management and operation of the South African seaports. It fulfils three important functions:

- Provides a concise summary of applicable laws, regulations and guidelines;
- Interprets or explains the applicability of the laws, regulations and guidelines; and
- Provides a basis for management programmes and initiatives.

Legislation affecting activities at the South African seaports occur at the international, national, provincial and local levels. Most of the pertinent clauses in international agreements and conventions are legislated through national acts and regulations.

The National Environmental Management Act aids as the overarching environmental law in the country and offers direction to sectorial legislation (RSA, 1998).

The compliance framework is developed to ensure compliance with relevant environmental legislation and the requirements of the National Ports Act (RSA, 2005) and any amendments thereof. The National Ports Authority and port users shall at all times ensure compliance with environmental legislation relevant to their operational activities. The requirements outlined in the Port Rules shall be considered and implemented as part of operational activities. South Africa has a number of key environmental legislation informed by the constitution, International Law, Domestic Legislation and associated supporting legislation (DEA, 2014). The Port Authority and all port users are bound to adhere to all of these pieces of legislation.

Refer to appendix 1 that indicates legislation regulating environmental matters on marine water quality within the seaport but is by no means exhaustive.

2.7 Marine water quality analysis and measures

Water quality assessment is based on targeted chemical, physical, microbiological and biotic analyses of the water column and underlying sediment (CSIR, 2013). Anastasopoulos, Kolios and Stylios (2011, p. 78) indicate that "water quality can be measured through a set of parameters such as "pH, temperature, salinity, turbidity, suspended solids, Biological Oxygen Demand, Chemical Oxygen Demand, *E.coli*, sulphide, lead, cadmium and mercury". CSIR (2016) recommend an approach to assessing the environment quality using an index. Absolute water quality variable numbers are of less value than to an index or classification system that defines the quality of the environment in to description grouping of either "excellent", "good", "fair" or "poor". This approach is useful for communicating monitoring programme findings to decision-makers that do not have scientific expertise to interpret data (CSIR, 2017). The South Africa's seaport monitoring programme comprises of summer and winter surveys. The summer surveys only focus on marine water quality whilst the winter surveys focus on marine water quality, sediment quality, benthic macro faunal community status and bioaccumulation of contaminants by mussels (CSIR, 2016).

Marine water quality is defined as "the concentration and dissolved or particulate of some or all of the organic and inorganic material present in the water, together with certain physical characteristics of the water; for an example concentration of toxic substances which may limit water use" (DWAF, 1996, p1). DWAF (1996, p.3) defines water quality as "chemical, biological, physical and artistic properties of water that determine its suitability for a variability of uses and for the safeguard of the health and integrity of aquatic ecosystems". Whereas, Encyclopedia.com (2016, p.1) defines marine water quality as "the existence or absence of pollutants (such as oil, sedimentation, sewage, nutrients, heavy metals, and industrial effluent pollution) in ocean waters". According to PIANC (2014), ports are striving towards the green and smart port aspects, which are linked to sustainability, water quality, and pollution conscious with the ultimate goal of preventing port operations from degrading the surrounding water quality.

In order to take measures to improve the water quality in the ports and to achieve defined standards; the Sustainable Development Goals (SDG's), which are virtually an extension of the

Millennium Development Goals (MDG's) that reached their life span in 2015 were formulated to continuously address the concerns of sustainable development (DEA, 2017). Sachs (2012, p. 2207; UN, 2017) state that "life below water is the SDG designed to sustainably manage and protect marine and coastal ecosystems from pollution and address the impact of ocean acidification while enhancing conservation and sustainable use of ocean-based resources through institutional mechanisms". The life below water sustainable development goal is reinforced by the World Wide Fund For Nature South Africa (WWF-SA) mission as they seek to minimise the degradation of the earth's natural resources by conserving the world's biological diversity, ensuring sustainable use of natural resources while promoting the reduction of wasteful consumption and pollution and build a future in which humans live in harmony with nature (WWF-SA, 2016).

2.7.1 Marine water quality monitoring guidelines

The South African Water Quality Coastal Marine Waters Guidelines were developed following an international review of similar guidelines, with the intention of developing guidelines suitable for the South Africa's coastline environments (DEA, 2012). DEA (2018b, p.1) commissioned a project to review the approaches followed in the development of water quality guidelines in 2016/17 financial year; 14 countries and ecoregions such as "Benguela Current Large Marine Ecosystem Programme, Western Indian Ocean Region, and international literature review formed part of this assessment". DEA (2018d) state that "Water Quality Guidelines for Coastal Marine Water were first published by the then Department of Water Affairs in 1995, now the Department of Water and Sanitation with the intention of managing the marine water resources for all designated uses, in this instance the natural marine environment" In recent years, the Department of Environmental Affairs took on the responsibility for marine discharges as mandated by the ICM Act. DEA (2014, p. 83) indicate that "under Section 69 of the ICM Act, the DEA seeks to regulate the discharge of effluent into the coastal waters from any sources on land by requiring that such discharges are authorised under a permit or general authorisation". However, when applying these guidelines, cognisance of the fact that these are just guidelines and not outright standards must be taken into account. It is also important to note that professional judgement and knowledge of the local environmental condition needs to be applied. The guidelines, in some instances, are excessively stringent even in areas with little or no anthropogenic based impacts.

Equally, the guidelines do not adequately address the synergistic of different pollutants found in many discharges. This is understandably challenging to assess, and in order to address this

challenge, in many instances, discharges have applied a Coastal Waters Discharge Permit to monitor point source discharges (DEA, 2014b). Notably, IISS (2013) indicate that the discharge limits on stormwater runoff from facilities worldwide are becoming more stringent. For example, Environmental Protection Agency (EPA) regulations for North American seaports have attempted to standardise the stormwater regulation approach (IISS, 2013).

2.7.2 South African Seaports Marine Water Quality Monitoring

Monitoring in this context is viewed with the principal philosophy of ecological parameters, where baseline data versus current status quo is fundamental in providing insights in the ecosystem. Long term data which could be question or mandate driven is analysed to provide meaningful information. Mandated monitoring is defined as environmental data gathering as required by legislation or directive (Lindenmayer & Likens, 2010). DEA (2012) and WRC (2015) indicate that the ecological status of the coastal and marine environment can be categorized as follows: good, fair and poor. Acknowledging the risks posed by port operations to the functioning of the marine environment, and in a quest to understand the ecological health and quality status of the South African seaport system, TNPA implemented surveys for the long-term ecological monitoring for seven out of eight South African seaports. The original bi-annual (summer and winter) sampling programme in each port was designed by the South African Environmental Observation Network (SAEON). The purpose of the long term monitoring is to track environmental quality in the ports and to determine where management actions are required for environmental quality improvements and evaluate the success of implemented actions. The appointment was aimed at (TNPA, 2015, p. 2):

1. "Ensuring compliance with legal requirements and standards whilst avoiding any possible legal or financial implications due to ship and land based pollution sources;
2. Ensuring that the water quality in the ports meet the acceptable monitoring parameters;
3. Allowing port environmental managers to keep a closer look at the environmental management goals;
4. Assisting with remedial actions for possible environmental pollution or degradation;
5. Ensuring continual improvement of the water quality through identifying specific and practical remedial actions; and
6. Obtaining marine quality data that is required by authorities for maintenance and operational permits where applicable".

The summer surveys mainly focuses on water quality (physical, chemical and microbiological in the water column) while the winter survey focuses on sediment and water quality; benthic

macro-fauna community composition and structure; and bioaccumulation of contaminants by mussels. Sampling programme at each port was informed by the ecosystem, social and economic activities and potential impact sources (CSIR, 2013). Notably, the monitoring programme is comprehensive to provide an understanding of areas in the port where water, sediment and/or biological communities are impaired, to identify likely causes of impairment evident, and to determine if management interventions are required to improve the quality of the ports aquatic environment (CSIR, 2017). The details of the summer (s) and winter (w) monitoring programme for the ports are indicated below. For the purposes of this study, South African Water Quality Guidelines for Coastal Marine Waters (DWAF, 1995) were adopted. Refer to appendix 2 for the detailed monitoring parameters. CSIR (2016, p. 11) state that "a water index was used to summarise water quality at each station based on the results for a suite of indicators, following an approach defined by the Canadian Council of Ministers of the Environment. The index considers the number of indicators that did not meet water criteria, the number of times water quality criteria were not met by each indicators, and the degree to which the value/ concentration for indicators exceeded water quality criteria". The index was then used to classify water quality into one of five narrative categories as indicated in Table 2.5, namely excellent, good, fair, marginal or poor".

Table 2.5 Water quality classification category

Excellent	≥95 (Water quality measurements never or very rarely exceed water quality targets)
Good	≥80 - <95 (Water quality measurements rarely exceed water quality targets and, usually, by a narrow margin)
Fair	≥65 - <80 (Water quality measurements sometimes exceed water quality targets and, possibly, by a wide margin)
Marginal	≥45 - <65 (Water quality measurements often exceed water quality targets and/or by a considerable margin)
Poor	<45 (Water quality measurements usually exceed water quality targets and/or by a considerable margin)

Source: Author compiled information from CSIR, 2016.

2.7.2.1 Port of Saldanha

The Port of Saldanha is monitored through an integrated Saldanha Bay and Langebaan lagoon monitoring programme. Research conducted by Clark et al., (2015) indicate that Saldanha Bay is considered to be one of the leading biodiversity locations in the country. The Environmental Management Framework in the Port of Saldanha identified key pressures to be coastal development and associated impacts from erosion and storm water discharge's to sea, marine pollution, disturbance and degradation of terrestrial and aquatic ecosystems (SEA, 2017). In Saldanha Bay, in an attempt to understand changes in the health of the environment, water quality aspects such as temperature, salinity, dissolved oxygen, nutrients and chlorophyll concentrations have been studied and continue to do so (Clark et al., 2017). Monitoring of microbiological indicators at 20 monitoring stations is conducted on a regular basis. Data collected is showing an improvement in the health status as previous data indicated that chronic problems with faecal coliform were present in the water, however, the status quo has since improved. In 2017 sixteen out of twenty monitoring stations in the Saldanha Bay are rated "Excellent" in terms of the water quality, one is rated "Good" two sites are rated "Fair" whilst one site is rated " Poor" (Clark, 2017).

Table 2.6 Summary of the water quality data for the Port of Saldanha

Year	No. of samples	Excellent	Good	Fair	Poor
2013	20	14	3	3	0
2014	20	13	2	2	3
2015	20	18	1	0	1
2016	20	16	1	3	0
2017	20	16	1	2	1

Note 1: The Saldanha classification status is inclusive of summer and winter

Source: Author compiled information from Clark et al., 2013; 2014; 2015; 2016; 2017.

The poorly rated sites are located close to the Bok River Mouth, the microbiological contamination is as a result of the waste water discharges into the bay. Looking at the five year

data set, data is not conclusive as monitoring classification seems to be marginally fluctuating, making it challenging to quantify.

2.7.2.2 Port of Cape Town

The port of Cape Town is situated in the south-eastern part of Table Bay and it is South Africa's oldest seaport. The port encompasses five basins (Ben Schoeman Dock, Duncan Dock, Victoria and Alfred Basins, and Entrance Basin) (CSIR, 2016). The port is also regarded as an important site for vessel and oil rig repairs and construction. Marine environment in the port is affected by a multitude of anthropogenic disturbances, these are inclusive of vessel propeller wash and dredging activities which cause a disturbance to sediment dwelling organisms, spillages of bulk cargo during port operations and introduction of contaminants from urban storm water runoff (CSIR, 2017).

Table 2.7 Summary of the water quality data for the Port of Cape Town

Year	No. of samples	Excellent ≥95	Good ≥80 - <95	Fair ≥65 - <80	Marginal ≥45 - <65	Poor <45
2013 (S)	12	0	12	0	0	0
2013 (W)	12	0	3	2	7	0
2015 (W)	12	5	5	2	0	0
2016 (S)	12	1	5	6	0	0
2016 (W)	12	0	4	6	1	1
2017 (S)	12	1	8	1	0	1
2017 (W)	12	4	5	3	0	0

Note 2: There was no monitoring conducted for year 2014 and summer 2015.

Source: Author compiled information from CSIR, 2013a; 2016a; 2017a.

The most significantly impaired water quality was in the Alfred Basin where metal concentrations were unusually higher than in other parts of the port and in the Duncan Dock where nutrient concentrations were high. Also, water quality in the Duncan Dock is consistently poor which is attributed to sewage inflow from the storm water outfall. Notably, in the Port of Cape Town most sites fall within the "fair" category (CSIR, 2017a).

2.7.2.3 Port of Mossel Bay

The Port of Mossel Bay is situated on the southern Cape coastline, in the town of Mossel Bay; the port essentially comprises of a single basin and deals mostly with fish industries and is the smallest commercial port in South Africa (CSIR, 2016d).

Table 2.8 Summary of the water quality data for the Port of Mossel Bay

Year & season	No. of samples	Excellent ≥95	Good ≥80 - <95	Fair ≥65 - <80	Marginal ≥45 - <65	Poor <45
2013 (S)	5	5	0	0	0	0
2013 (W)	5	3	2	0	0	0
2015 (W)	6	0	2	4	0	0
2016 (S)	6	4	2	0	0	0
2016 (W)	6	4	1	0	1	0
2017 (S)	6	5	1	0	0	0
2017 (W)	7	1	6	0	0	0

Note 3: There was no monitoring conducted for year 2014 and summer 2015.

Source: Author compiled information from CSIR, 2013c; 2016d; 2017d.

In 2013, most monitored sites were classified as excellent and good. In winter 2015, sites monitored were classified as fair, whereas, in 2016, most monitored sites were classified as excellent. The most recent monitoring in 2017, most monitored sites were classified as excellent.

2.7.2.4 The Port of Port Elizabeth

The Port of Port Elizabeth is situated on the western shoreline of Algoa Bay. The port essentially comprises three basins, namely the northern, southern and entrance basins, and an entrance channel (Transnet, 2017).

Table 2.9 Summary of the water quality data for the Port of Port Elizabeth

Year	No. of samples	Excellent ≥95	Good ≥80 - <95	Fair ≥65 - <80	Marginal ≥45 - <65	Poor <45
2013 (S)	9	0	6	3	0	0
2013 (W)	11	6	2	0	3	0

2015 (W)	10	0	8	2	0	0
2016 (S)	10	1	9	0	0	0
2016 (W)	10	8	2	0	0	0
2017 (S)	10	9	0	1	0	0
2017 (W)	10	8	1	1	0	0

Note 4: There was no monitoring conducted for year 2014 and summer 2015.

Source: Author compiled information from CSIR, 2013e; 2016f; 2017f.

The "fair" water quality in the Port of Port Elizabeth is mainly associated with anthropogenic contaminants from the Baakens River and the manganese handling terminal.

2.7.2.5 Port of Ngqura

The Port of Ngqura is situated on the north-western shoreline of Algoa Bay, about 20 km to the northeast of Port Elizabeth. It is South Africa's newest commercial port, with the first vessel having entered the port in October of 2009. The Port of Ngqura is the fastest growing port in the country and construction is therefore ongoing. The port is of deep-water type, capable of servicing post-Panamax dry and liquid bulkers and new generation cellular container ships (Transnet, 2017).

Table 2.10 Summary of the water quality data for the Port of Ngqura

Year	No. of samples	Excellent ≥95	Good ≥80 - <95	Fair ≥65 - <80	Marginal ≥45 - <65	Poor <45
2013 (S)	7	7	0	0	0	0
2013 (W)	7	6	1	0	0	0
2014 (W)	7	0	5	2	0	0
2015 (W)	7	4	3	0	0	0
2016 (S)	7	3	4	0	0	0
2016 (W)	7	6	1	0	0	0
2017 (S)	7	7	0	0	0	0
2017 (W)	7	0	7	0	0	0

Note 5: There was no monitoring conducted in summer of 2014 and summer 2015.

Source: Author compiled information from CSIR, 2013d; 2016e; 2017e.

The Port of Ngqura "excellent" and "good" water quality status is attributed to minimal anthropogenic activities in and around the port. Also, the Port of Ngqura is the youngest port amongst the 8 South Africa's commercial seaports, built with stringent environmental conditions embedded in the Operational Environmental Management Plan.

2.7.2.6 Port of East London

The Port of East London is the only river port in the South African port system (CSIR, 2017). However, just like many other ports, it is surrounded by industrialised and urbanised areas.

Table 2.11 Summary of the water quality data for the Port of East London

Year & season	No. of samples	Excellent ≥95	Good ≥80 - <95	Fair ≥65 - <80	Marginal ≥45 - <65	Poor <45
2013 (S)	7	0	0	6	1	0
2013 (W)	7	0	2	2	3	0
2015 (W)	6	0	1	1	0	4
2016 (S)	6	0	1	5	0	0
2016 (W)	6	0	0	0	6	0
2017 (S)	6	0	0	1	4	1
2017 (W)	6	3	3	0	0	0

Note 6: There was no monitoring conducted for year 2014 and summer 2015.

Source: Author compiled information from CSIR, 2013g; 2016c; 2017c.

Water quality status in the Port of East London is often poor with high bacteria counts and nutrient concentrations due to the inflow from the Buffalo River.

2.7.2.7 Port of Durban

The port is an important resource for Durban's citizens to access for education, social and most importantly for recreational activities. As much as the Port supports these activities and uses, it has over the past years become increasingly degraded due to a variety of stresses placed on this sensitive ecosystem (DEA, 2016a). The port faces challenges regarding the large amount of waste that is discharged into the port on a regular basis through the network of storm water outfalls and rivers that drain into the port. The combined catchment area of rivers, canals and storm water system that drain into the port as far afield as Assagay is over 250 km^2 in size and

the unfortunate reality of that is, the port waters have been on the receiving end of a large amount of waste that enters the storm water reticulation system within the catchment area. The waste that is discharged into the port not only impacts on aesthetics of the port, it also has a profound impact on port users, the marine and bird life and alarmingly, it is posing a significant risk to port operations as it poses a navigational hazard for vessels and can cause mechanical damage to large vessels as well as recreational craft (CSIR, 2016b).

Table 2.12 Summary of the water quality data for the Port of Durban

Year	No. of samples	Excellent ≥95	Good ≥80 - <95	Fair ≥65 - <80	Marginal ≥45 - <65	Poor <45
2013 (S)	15	3	8	1	1	2
2013 (W)	15	2	5	4	3	1
2015 (W)	15	4	5	5	0	1
2016 (S)	15	0	8	6	0	1
2016 (W)	15	2	6	1	3	3
2017 (S)	15	4	9	0	2	0
2017 (W)	15	6	3	2	2	2

Note 7: There was no monitoring conducted for year 2014 and summer 2015.

Source: Author compiled information from CSIR, 2013b; 2016b; 2017b.

Water quality impairment in the upper reach of the Bay is due to the introduction of contaminants by the Amanzimnyama, Umhlathuzana and Umbilo Rivers and these appear to be highest contributors of anthropogenic contaminants to the Bay. Other anthropogenic sources of contaminants include surface run off from neighbouring industrialised and urbanised areas, vessel maintenance and construction facilities, and the spillages of cargo during loading and offloading of vessels (CSIR, 2017b).

2.7.2.8 Port of Richards Bay

The primary function of this port is the trade of bulk cargo and plays a major role in coal export. The port is fairly unique in the context of other South African ports, however, since only about 40% of the land surface area has been developed. Large areas of fairly undisturbed habitat, including extensive intertidal sand and mudflats and mangroves, exist alongside port infrastructure (TNPA, 2017).

Table 2.13 Summary of the water quality data for the Port of Richards Bay

Year	No. of samples	Excellent ≥95	Good ≥80 - <95	Fair ≥65 - <80	Marginal ≥45 - <65	Poor <45
2013 (S)	12	2	8	1	0	1
2013 (W)	12	6	6	0	0	0
2015 (W)	11	2	8	1	0	0
2016 (S)	11	8	3	0	0	0
2016 (W)	11	10	1	0	0	0
2017 (S)	10	4	4	1	0	1
2017 (W)	11	6	4	1	0	0

Note 8: There was no monitoring conducted for year 2014 and summer 2015.

Source: Author compiled information from CSIR, 2013f; 2016g; 2017g.

The fair water quality classification for Bhizolo and Mzingazi canals is as a result of anthropogenic contaminants from the surrounding urban and industrial areas (CSIR, 2017g).

2.8 Marine Water Quality Management Programmes

Ports and maritime sectors around the world have acknowledged a sustainability need and calls for action that allows for economic benefits without compromising the surrounding communities and the environment (IISS, 2013). In its quest for environmental stewardship, TNPA has been working with key government stakeholders to develop management programmes for port marine environments that are of national importance.

The ICM Act, DEA (2014a, p. 20) was promulgated to establish the statutory requirements for integrated coastal and estuarine management in South Africa and encompasses a variety of tools that are utilized as significant tools for "the conservation of the coastal zones; ensure that development is conducted in an environmentally sustainable manner; and contraventions by groups or individuals are dealt with through appropriate procedures". DEA (2014a, p. 21) indicate that Coastal Management Programmes (CMPs) are arguably the most powerful integrating tools. CMPs are regarded for the management of the coastal zone as the policy directives, "inclusive of strategies and plans for the effective implementation of the ICM Act that enables the organs of state to plan and to set a plan for the future environmental use of a nation conflicts by addressing current management problems, user-conflicts and long term

development and management of the coastline". As such, provincial and municipal CMPs need to align with nation-wide objectives to accomplish respective directives in terms of the nine coastal management priorities (DEA, 2014a).

2.8.1 World Oceans Day

In pursuit of sustainable global ocean management, as from 1992, the World Oceans Day is celebrated annually with the intention of emphasising the importance of the ocean in daily living; not withstanding to raise awareness regarding the impact humans have on the ocean and most importantly to bring to the fore the challenges faced by the global community in relation to the oceans (DEA, 2016c). The United Nations officially recognised this day in 2008, and has since been observed on the 8th of June.

2.8.2 Marine Spatial Planning

DEA (2017, p. 3) indicate that Marine Spatial Planning (MSP) vision is "a productive, healthy and safe ocean that is accessible, understood, equitably governed and sustainably developed and managed for the benefit of all". UNESCO (2015) state that management tools such as regional conventions and MSP's can safeguard multi-stakeholder ocean governance and provide for regional collective actions. Notably, Ehler and Douvere (2009, p. 7) define MSP's as "a governance method and a practical way of achieving economic, social and ecological objectives by collaboratively evaluating and managing the distribution of the spatial and temporal distribution of human undertakings". MSP provides a mechanism to improve the coherent planning, management and governance of the ocean space and marine resources (Ehler & Douvere, 2009; DEA, 2017; Walker 2018). Walker (2018) indicate that oceans are regarded as valuable ecosystems to the well-being of humans; ocean and human interface, if not adequately managed, may result in marine environment and human uses conflicts. Derraik (2002) indicate that a major decline in biological diversity are as a result of human activities.

2.9 Concluding Remarks

Through the length and breadth of the South African coastline, marine environments are important to the sustainability and development of livelihoods. However, many factors either internally or externally have an impact on the port environment. First, a number of institutional structures have a role to play in ensuring competitive and sustainable ports, therefore, definitive roles and responsibilities to guide against gaps and overlaps are obligatory. Second, the cross functional mandate in respect of marine pollution issues and the current division of marine

pollution control functions requires consideration as it currently focuses mainly on oil pollution emergencies. Third, marine environment stressors identified requires implementation and enforcement of the existing legislation and most importantly, the adoption of precautionary measures. Fourth, as an emerging country, South Africa endlessly needs to stabilise the commercial opportunities which the oceans and coast affords the country whilst preserving its environmental integrity. Fifth, the Sustainable Development Goals provide a strong motivation for regional and institutional cooperation to support the coordinated effort to address ocean related objectives across shared networks. Lastly, the key to achieving better ocean governance is for relevant stakeholders to adopt an integrated coastal management approach adaptive to marine dynamics. The next chapter discusses the research methodology used for this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The purpose of this chapter is to provide an understanding into the research methodology used in this purposive qualitative study and the manner in which data was collected to answer the key research question on examining marine water quality management practices in South African seaports. In the literature review, chapter two, the following topics were discussed: governance structures, legal framework, functions of the marine coastal environment and anthropogenic factors with respect to marine water quality management in South African seaports. However, these topics were not completely addressed in the literature available, as a result, these topics shaped the plan for the study.

Marine water quality management is an enormous study, one that cannot be grappled with just on one study. However, the research methodology employed required to be planned in a manner that the research queries on marine water quality management in South African seaports were satisfactorily addressed by the targeted participants with the necessary knowledge of the subject matter. Therefore, this is a deductive qualitative inquiry, which seeks to move from the universal perceptions to a specific case (Saunders, Lewis & Thornhill, 2016).

This chapter is structured as follows. Section 3.2 discusses the research design which includes, research philosophy, approach to theory development, methodological choice, qualitative research method, time prospects and lastly, techniques and procedures inclusive of pre testing of the interview guide, data recording and other sources of data. Section 3.3 explains the sampling technique and participants in the study. Section 3.4 discusses methods of data analysis, which includes data analysis in qualitative research and thematic analysis. Section 3.5 discusses validity, reliability and trustworthiness. Section 3.6 discusses credibility and authenticity. Section 3.7 explains research limitations. Section 3.8 explains ethical considerations. Section 3.9 concludes.

3.2 Research design

Saunders, Lewis and Thornhill (2016, p. 5) defines research "as a process that people undertake in a systematic way in order to find out things, thereby increasing knowledge". According to

Saunders, Lewis and Thornhill (2016), research design is a broad-spectrum strategy for answering research questions guided by clear objectives, data collection sources and employed analytical tools. Maxwell (2012) indicates that in a qualitative study, research design at every phase of a project should be a spontaneous operating technique. Notably, Maxwell (2012) indicates that qualitative research requires a wider and less limiting concept of organisation compared to the traditional designs. For the purposes of guiding this study, the "research onion" was applied to describe the method followed. Saunders, Lewis and Thornhill (2016) indicate that the research process comprises of six layers of research design. Table 3.1 gives an overview of the six layers of the research onion, these elements are further explained in more detail in section 3.2.1 to 3.2.6. Figure 3.1 is the research onion layers.

Table 3.1 Six layers of the research onion

Layer 1	Research philosophy
Layer 2	Approach to theory development
Layer 3	Methodological choice
Layer 4	Strategies
Layer 5	Time prospect
Layer 6	Techniques and procedures

Source: Author compiled information from Saunders, Lewis and Thornhill, 2016, p. 164

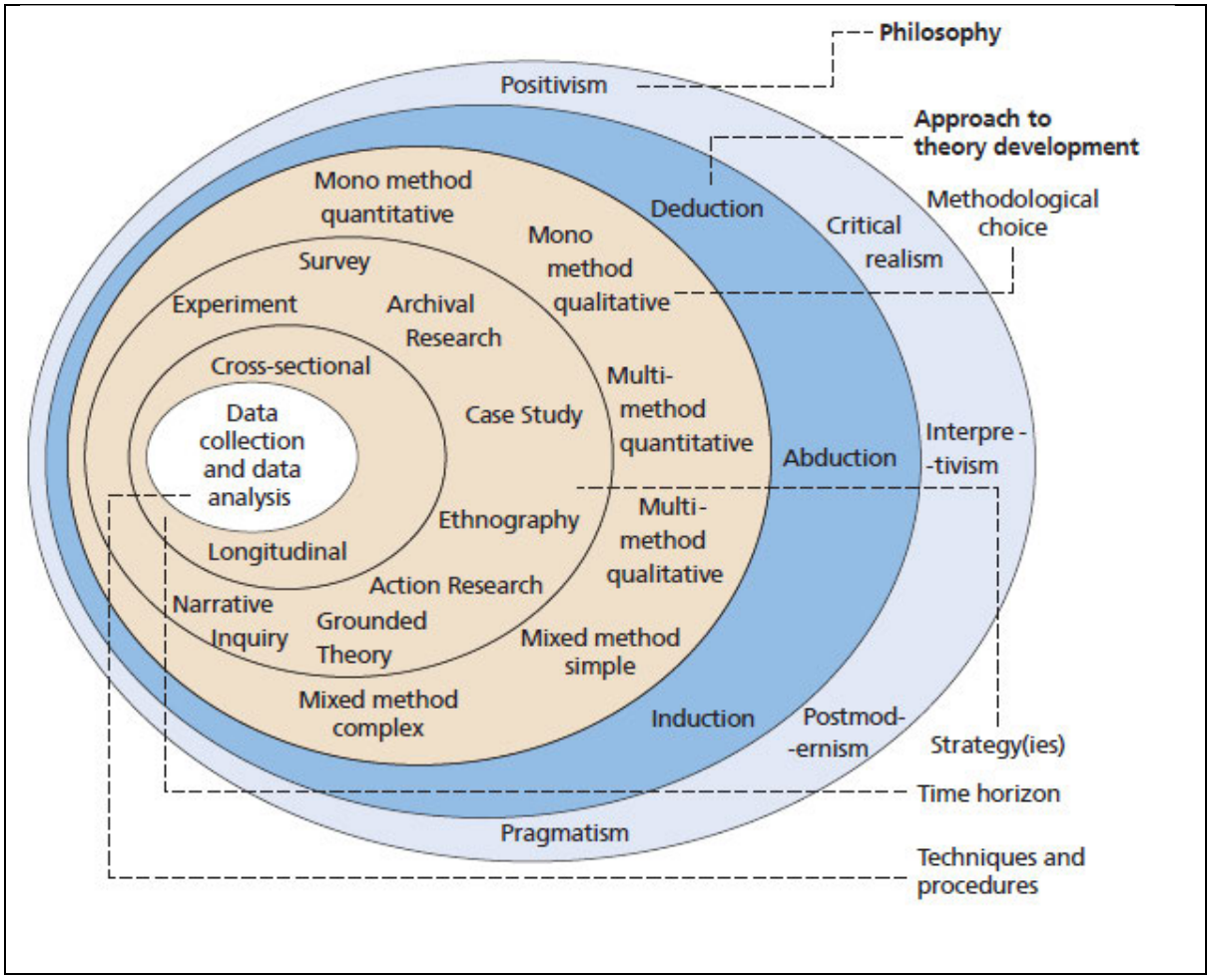

Figure 3.1 Research Onion

Source: Saunders, Lewis and Thornhill, 2016, p. 164.

3.2.1 Research philosophy

The research conducted by Saunders, Lewis and Thornhill (2016), indicate that research philosophy is about development of understanding structures. Poggenpoel, Myburgh and Van der Linde (2001) indicate that qualitative investigation is often regarded as an interpretive philosophy as the researcher needs to make intellect of the personal and generally constructed meanings articulated about the phenomenon being studied. Often this type of study is also referred to as a realistic study due to its easy flowing natural setting for the establishment of belief, participation, and access to values and in-depth understanding (Saunders, Lewis & Thornhill, 2016). For the purpose of this study, the interpretive philosophy was followed to gain in-depth understanding of marine water quality management in South African seaports.

3.2.2 Approach to theory development

In many aspects, qualitative investigation begins with an inductive approach to the development of theory, in this aspect, realistic and emergent research designs are used to build theory (Saunders, Lewis and Thornhill, 2016). Hoepfl (1997) indicate that, qualitative investigation practises a naturalistic tactic that pursues to understand phenomenological inquiry in context of a detailed setting. It is prudent to highlight that some qualitative research approaches commence with a deductive method, this is done to test an existing philosophy by means of qualitative procedures (Saunders, Lewis & Thornhill, 2016). In practical terms, Saunders, Lewis and Thornhill (2016, p. 168) state that "qualitative research employs an abductive approach to philosophy development where inductive interpretations are established and deductive ones are verified iteratively during the investigation".

3.2.3 Methodological choice

Creswell (2014, p.12) indicate that there are "three types of research methodologies; qualitative, quantitative and mixed methodology". The methodologies are employed in different research settings depending on the environment and question the study is seeking to answer (Marshall, 1996; Creswell, 2014). For this study, qualitative methodology is employed.

Participants' meanings and relationships are aspects that the qualitative investigation aims to explore, by means of data collection techniques and investigative procedures to develop a conceptual framework and theoretical contribution. Saunders, Lewis and Thornhill (2016) indicate that data collection process is non-standardised to allow for an investigation process that is respectively realistic and cooperative and may use multi techniques for data gathering methods. Creswell (2014) indicate that the investigator may conduct with the participants a face-to-face, telephonic or focus group interviews. These are often semi-structured or generally "open ended questions" that are restricted in numbers and intend to elicit interpretations and sentiments from the participants.

3.2.4. Qualitative research method

Qualitative approaches in recent years have increasingly gained acceptance and are influential tools for improving teaching and learning understanding (Hoepfl, 1997). Marshall (1996) indicate that qualitative sampling typically requires a practical and flexible approach. Whereas, Hoepfl (1997, p. 49) indicate that "qualitative method is used in situations where new perspectives on effects about which much is already identified or to gain additional information

that may be challenging to express quantitatively". Research conducted by Bricki and Green (2007) indicate that qualitative methodology is characterised by its methods of data analysis looking at matters related to social life aspects through wording rather than generating calculations. According to Golafshani (2003) qualitative research method produces outcomes not attained by way of statistical or quantification techniques but rather outcomes attained from natural sceneries. Hoepfl (1997) support the view that to comprehend occurrences in a realistic perspective, qualitative research is the best methodology to pursue. Whereas, Srivastava and Thomson (2009, p.73) define qualitative research "as an inquiry process of understanding based on distinct and methodological traditions of inquiry that explore a social or a human problem". It is further maintained that methodology implemented is also reliant on the fundamental research objectives and questions (Srivastava & Thomson, 2009).

In qualitative research methodology, diverse as it is, data is often obtained through participants interviews (Smith & Firth, 2011). According to Bricki and Green (2007, p.3) qualitative methods "in general target to appreciate the practises and attitudes of people, community and most importantly targets to answer enquiries around "how, what or why" of a phenomenon". Whereas, O'Reilly and Parker (2013) indicate that qualitative research is anxious about the abundance of the information. Furthermore, Golafshani (2003) state that researchers in qualitative approaches embrace their role and involvement within the research. Priebe and Strang (2016) indicate that participant's perspectives are prominent in qualitative studies.

In order to gain an in-depth understanding of why things are happening, a qualitative investigation is the exploratory approach habitually employed (Creswell, 2014). This approach provides insight and deep understanding of the problem. In qualitative research, variables are not controlled, there is a freedom of expression which is demonstrated by participants. Data to be collected is not limited to predetermined boundaries. Respondents to the study are exposed to open ended questions and they have freedom of expression. Inductive approach is used in conducting qualitative research, very narrative and interpretive. Saunders, Lewis and Thornhill (2016, p. 169) indicate that different types of qualitative research approaches are available, namely; "basic interpretative study, case study, document or content review, ethnography, grounded theory, historical study and phenomenology study". Furthermore, qualities of qualitative research are discussed in Table 3.2.

Table 3.2 Qualities of qualitative research

Employs natural settings as the source of data
Researcher acts as the human mechanism of data collection
Inductive and deductive data analysis are predominantly used
Reports in the qualitative research are descriptive, incorporating easy-to-read language, inclusive of participant voice in the writing
Interpretive character with the objective of discovering the events meaning for the individual who has been exposed to those events and for the researcher to interpret
The researcher seeks to interpret the uniqueness of each case
It is emergent in nature, allowing the researcher to identify emerging patterns
Qualitative research is adjudicated based on a distinct criteria for trustworthiness

Source: Author compiled information from Hoepfl, 1997; MacDonald, 2012; Creswell, 2014.

3.2.5 Time prospect

Due to time constraint most academic explorations use a cross-sectional time horizon as opposed to longitudinal. Cross-sectional studies habitually implement the survey strategies (Saunders, Lewis &Thornhill, 2016). Longitudinal research strength lies in its ability to study change and development over time. For the purposes of this research, the cross-sectional study has been embraced.

3.2.6 Techniques and procedures

Creswell (2014) indicate that data collection protocol takes into account study boundary, sourcing of information (through "unstructured or semi structured interviews, observation, visuals", etc.) and determine suitable ways of information recording.

Within the qualitative investigation, the dominant data collection forms are interviews and observations (Hoepfl, 1997). Hoepfl (1997, p. 52) indicate that "qualitative interviews make use of "open ended questions that allow for individual variations".

Researchers such as Saunders, Lewis and Thornhill (2016, p. 390) state that there are three types of qualitative interviews, namely, "informal, conversational interviews, semi-structured interviews, and standardised, open-ended interviews".

Additionally, interview guides allow for flexibility and ensure good use of limited interview time, keep interactions focused, and makes the interview process of multiple subjects methodical and complete (Hoepfl, 1997).

For the purposes of this study, semi-structured interview were employed. An interview guide was developed with a list of basic questions to guide the interviews. The interviewer is allowed to explore within the predetermined questions as there are no pre-set responses (Hoepfl, 1997).

The interviewees were asked the following questions based on the objectives of this study.

- Could you describe the current marine water quality management practices in the ports?
- What are the most contributing factors to marine water quality in the ports?
- How does the water quality monitoring data impact on pollution prevention strategies for the ports?
- Outline the marine pollution prevention strategies implemented in the past years and how they assisted in the management of marine water quality?
- What more can be done to improve marine water quality management in the ports?
- Is there anything to add regarding the management of marine water quality in the ports?

Pre testing of the interview guide

The nature of the qualitative design allows for the modification of the interview guide to exclude aspects found to be fruitless for the objectives of the research. For the purposes of this study, three environmental specialists were asked questions as per the interview guide, and they understood what the researcher was trying to achieve, as a result, the interview guide was not modified as it addressed the objectives of the study.

Data recording

The semi-structured interviews were audio recorded, and written notes were taken as backup. The interviewees consented to the interview and audio recordings, Refer to appendix 3 for the informed consent form.

Other data sources

Other information sources compiled and examined included the CSIR Ecological Monitoring Reports for the seven ports (CSIR, 2013; 2014; 2016; 2017) and the Anchor Environmental reports for the port of Saldanha (Clark et al., 2013; 2014; 2015; 2016; 2017).

3.3 Sampling technique

Saunders, Lewis and Thornhill (2016) indicate that sampling techniques are mainly divided into two types, probability and non-probability. Probability samples, the target population is known and the probability to answer research questions and achieve study objectives is statistically likely. Whereas, with non-probability samples, the target population is unknown and the chances to answer research questions and achieve study objectives and draw inferences are statistically unlikely (Saunders, Lewis & Thornhill, 2016). Non-probability sampling offers a variety of alternative techniques (such as quota, purposive, volunteer and haphazard) to select samples (Saunders, Lewis & Thornhill, 2016). In this study purposive sampling was the technique employed. According to Hoepfl (1997) in qualitative research, purposeful sampling is the dominant strategy which pursues data rich environments that can be studied in-depth. Creswell (2014, p. 189) indicate that "the idea behind qualitative research is to purposefully select participants or sites that will best help the researcher understand the problem and the research questions". Marshall (1996, p. 523) share the same sentiments by stating that "the researcher actively selects the most productive sample to answer the research questions". According to Hoepfl (1997), there are various types of purposive sampling namely: snowball or chain sampling; typical case sampling; deviant or extreme case sampling; maximum variation sampling, etc. The most useful being the maximum variation sampling for the naturalistic approach (Hoepfl, 1997). The maximum variation sampling allows data collection to define and explain observed key themes (Hoepfl, 1997; Saunders, Lewis &Thornhill, 2016). In a nutshell, participants' must be able to meaningfully deliver relevant data to the investigation.

3.3.1 Participants in the study

In this purposive sampling study, participants were selected based on:

- Study objectives and research questions;
- Practical knowledge of the study area; and
- Experience on marine water quality.

Saunders, Lewis and Thornhill (2016, p. 301) indicate that "with purposive sampling you need to use your judgement to select cases that will best enable you to answer research questions and meet objectives". Furthermore, the participants were chosen based on the role they play on marine water quality management.

The National Environment Manager's role to provide professional and credible advise and effective support on all environmental and environmental compliance oversight to achieve compliance with the requirements of the all environmental by providing direction, management and leadership to all relevant stakeholders in TNPA.

TNPA Environment Managers were chosen as a result of the oversight role on environmental monitoring. The environment managers are required to implement and manage environmental philosophy, processes and systems and to ensure responsible environmental conduct by complying with legal and other requirements.

Environmental Specialists are expected to lead all environmental management systems, processes and initiatives and direct activities for the entrenchment of environmental management practices and regulatory compliance through the analysis and treatment of environmental risk attached to any process that may result in environmental degradation or impact negatively on the ports bio-diversity, the organizations reputation and sustainable utilization of the environment in a manner that fulfils the mission and strategic goals of the organization.

Harbour Master's role is to ensure the provision of an efficient, safe and secure maritime environment within port limits in accordance with the Ports Act, Port Rules, Statutory requirements, Bylaws and Transnet National Port Authority's directives and policies and the Search and Rescue Act. Through the provision to our clients of a professional and efficient Pilotage service, dredged channels and basins, maintained depths at berths, and the provision and maintained navigational aids.

SAMSA role is to ensure "maritime safety, protecting and preventing the pollution of the marine environment by ships and the promotion of South Africa's interests" (SAMSA, 2015).

CSIR role as stipulated in the TNPA terms of reference is to develop a chart and long term monitoring plan for the ports, monitor marine water quality within the port, identify the potential origin of pollution, estimate the contribution of activities associated with the port on water quality, provide data to assess the long term ecologically sustainable development of the ports and ensure there is consistency in data gathering for long term trend analysis and gather environmental significant data to assist with the management of the port and its operations. Principal Researcher's and Researcher's roles are to monitor marine water quality for the ports and develop a short and long term monitoring plan for the ports, during the monitoring identify potential origin of pollution, quantify port activities contribution on marine water quality a provide feasible management interventions (TNPA, 2015). Table 3.3 below gives a synopsis of the participants in the study.

Table 3.3 Participant's synopsis

Institution and reference	Designation and location	Date interviewed
TNPA 1	National Environment Manager: TNPA Head Office	12 April 2019
TNPA 2	Environment Specialist: Durban	2 May 2019
TNPA 3	Environment Manager: East London	6 May 2019
TNPA 4	Deputy Harbour Master: Durban	30 April 2019
TNPA 5	Harbour Master: Durban	2 May 2019
TNPA 6	Environment Manager: Richards Bay	10 May 2019
TNPA 7	Assistant Environment Manager: Port Elizabeth	15 May 2019
TNPA 8	Environment Specialist: Cape Town	20 May 2019
TNPA 9	Environment Manager: Saldanha	21 May 2019

TNPA 10	Safety, Health And Environment Manager: Mossel Bay	16 May 2019
CSIR 1	Principal Researcher: Durban	24 April 2019
CSIR 2	Researcher: Durban	24 April 2019
SAMSA 1	Senior Manager : Navigation, Security & Environment: Cape Town	30 April 2019
SAMSA 2	Marine OHS Specialist: Durban	10 May 2019

Source: Author compiled from the purposive participants list.

3.4 Methods of data analysis

Saunders, Lewis and Thornhill (2016, p.569) state that "research commences from either a deductive or an inductive approach". Both deductive and inductive approaches are essential to qualitative data analysis (Burnard et al, 2008). Deductive approach is famous for using a predetermine structure. Whereas, inductive approach uses tangible data to develop the structure of analysis. This is a deductive qualitative study which seeks to move from the universal concepts to a specific situation (Saunders, Lewis & Thornhill, 2016).

Graneheim and Lundman (2004) indicate that there are two aspects to take into consideration when analysing the qualitative data. Manifest content analysis is descriptive and it's about what you can immediately recognise. Whereas, latent is about what you discover as you read and analyse the data.

3.4.1 Data analysis in qualitative research

Malterud (2001) indicate that qualitative research methods comprise of the orderly collection, organisation, and explanation of written material resulting from discussions or observations. Creswell (2014, p. 195) indicate that "the intention of data analysis is to make sense of the text and image, which involves segmenting, taking apart as well as putting it back together". Smith and Firth (2011, p. 3) support the view that "qualitative data analysis approaches can be divided into socio linguistic, theory development and describing and interpreting participants' views on content and thematic analysis methods".

3.4.1.1Thematic analysis

Braun and Clarke (2006) define thematic analysis as a process of recording and examining identified themes. According to Maguire and Delahunt (2017) thematic analysis is defined within the qualitative data, as a procedure for identifying patterns and it is not tangled to a particular epistemology or theoretical perspective unlike other qualitative methodologies. Braun and Clarke (2006, p. 78) indicate that thematic analysis "should be seen as a foundational method for qualitative analysis". Additionally, thematic analysis is flexible. Creswell (2014) and Maguire and Delahunt (2017) suggest the following steps in illustrating potential codes and themes that might emerge in the study, see Table 3.4.

Table 3.4 Sequence of data analysis in qualitative research.

Step 1:	Organise and prepare the data for analysis – data familiarity
Step 2:	Read all the data received to reflect on the overall meaning, depth and credibility of the information – generate initial codes
Step 3:	Begin coding all of the data. This is the process of organising the data by grouping text or images into categories and labelling those categories with a term in the actual language of the participants – search for themes
Step 4:	Involves the use of the coding process to generate themes for analysis – review themes
Step 5:	Progress on how the description and themes will be represented in the qualitative narrative (define themes)
Step 6:	Last step in data analysis which involves making an interpretation in qualitative research of the findings (data write up)

Source: Author compiled information from Creswell, 2014; Maguire and Delahunt, 2017

The researcher in this study applied the steps in table 3.4 and read through the transcripts a number of times to be familiar with the data. Data was categorised and coded into themes and sub-themes regarding marine water quality management in South African seaports. Subsequently, themes were defined and presented as findings of this study.

3.5 Validity, reliability and trustworthiness

Validity in qualitative research is an indicator that suitable procedures have been implemented to acquire the findings, while reliability indicates that the investigator's methodology is constant throughout the research process (Creswell, 2014). Kolb (2012, p.85) state that "it is

the researcher's responsibility to take precautionary measures to confirm areas of validity within his/her research". Golafshani (2003) indicate that a praiseworthy qualitative study assists to comprehend a situation that would have been rather challenging. Creswell (2014) indicate that there is a direct link between reliability and validity of the study to that of the findings of the research. Validity and reliability addresses the issue of consistency, replication, and appropriateness of the processes used in research findings. It gives comfort that the research result can be reproduced if the study were to be repeated by a different researcher. Validity tests the credibility of the research study (Creswell, 2014). It has been noted that validity and reliability are tested differently between qualitative research and quantitative research as their approaches are not grounded on the same principles.

Graneheim, Lindgren and Lundman (2017, p. 33) state that "trustworthiness in qualitative research is an overarching concept encompassing credibility, dependability, confirmability, transferability and authenticity". This study to achieve trustworthiness uses interviewees' quotations as part of the data analysis to prioritise the voice of the participants.

In qualitative research, credibility has been identified as a fundamental objective. Whittemore, Chase and Mandle (2001, p. 530) state that "authenticity is closely linked to credibility in validity and involves the portrayal of research that reflects the meanings and experiences that are lived and perceived by the participants". For this study to achieve credibility, participants were purposively selected based on experience, expertise and the ability to relate to what is currently happening in the ports in relation to marine water quality management practices.

3.6 Research limitations

Not all interviews were conducted face-to-face due to participants' geographic location. Teleconference was conducted and this enabled the researcher to audio record the interviews. As previously indicated, the researcher of this study is currently employed as an Environment Manager in the Port of Durban. The researcher was excluded as a participant in the interview process. The shortfall was however compensated for by interviewing an environmental specialist exercising an oversight role on marine water quality management in the port. Another limitation was that currently not all ports have environmental managers, and relevant personnel within the field were identified and interviewed accordingly. Notably, the study methodology targeted a group of participants based on a purposive sampling technique to contribute to the study, whereas, the institutional structures of marine water quality and coastal management are very comprehensive, leaving room for further studies to interview these additional institutions,

such as DEA, DAFF, DoT, SANBI and many more. More importantly, further studies should include the marine fishing industry as participants to gauge their perspectives on marine water quality management. Also, future studies could be more quantitative in order to statistically quantify the marine water quality impact on the port environment.

3.7 Ethical considerations

The main principles of ethics in research is to maximize benefits and minimize harm (Saunders, Lewis & Thornhill, 2016). Research conducted by Maxwell (2012) indicate that in qualitative research ethical concerns are increasingly being recognised as a necessity. An important element in research is the issue of ethics which addresses the question of moral integrity and professionalism in conducting studies. It sets high levels of conduct during the period of the research study. Research ethics sets the platform for research acceptance by other stakeholders. The researcher must be sensitive in dealing with information. A question of confidentiality becomes the anchor in managing data collected. The key components of research ethics is that participants must give consent to participate in the study (Du Plooy, Davis & Rose-Marie, 2014). The researcher's views and opinions will not be raised during interviews. It is critical that the participant's views are respected at all times. The interviews will solicit interviewees' honest opinion in relation to marine water quality management in South Africa's seaports.

For the purposes of this study, gatekeeper's letters were obtained from the TNPA, SAMSA and CSIR. Thereafter, the researcher submitted an ethical clearance application to the Humanities and Social Sciences Research Ethics Committee at the University of Kwa-Zulu Natal for ethical clearance. Approval to conduct the study was granted, see ethical clearance attached in appendix 4.

3.8 Conclusion

The purpose of this chapter was to define the research methodology utilised for this study. The aims and objectives were clarified and the data gathering process mapped out. In this chapter, the research paradigm of the qualitative study has been discussed. The research methodology chosen was discussed in detailed to reveal how the purposive qualitative research was conducted to examine marine water quality management in South African seaports. Qualitative interviews were conducted with fourteen targeted participants from the TNPA, the CSIR and

the SAMSA. The study used purposive sampling to identify participants for the study. Validity, reliability and trustworthiness were discussed, followed by credibility and credibility and authenticity. Finally, research limitations and ethical considerations were addressed in this chapter. Outcomes of the study are presented in the following chapter.

CHAPTER FOUR

DATA ANALYSIS

4.1 Introduction

The purpose of this chapter seeks to present findings of this study. As previously highlighted, the main objective of this study was to examine marine water quality management practices in South African seaports. In this regard, the chapter is structured as follows. Section 4.2 presents themes on marine water quality management practices. Section 4.3 presents contributing factors to marine water quality. Section 4.4 looks at monitoring data impact on pollution prevention strategies. Section 4.5 presents effectiveness of pollution prevention strategies. Section 4.6 presents additional recommendations on marine water quality management.

Furthermore, for ease of reference, respondents' quotations are labelled as follows: TNPA interviewee (1- 10), SAMSA interviewee (1-2) and CSIR interviewee (1-2), refer to Table 3.3 for participants details. This study uses the Harvard style to reference quotes from the interviews.

4.2 Marine water quality management practices

Interviewees were asked to describe the current marine water quality management practices in the ports. The study established that marine water quality management practices were characterised by (1) long term ecological monitoring, (2) sediment assessment (3) legislative mandate, and (4) early warning systems. The responses were analysed and Table 4.1 show the main themes that were recorded frequently.

Table 4.1: Themes on marine water quality management practices

Focus of themes	**Number of interviewees identifying themes**
Long term ecological monitoring	10
Sediment assessment	10
Legislative mandate	9
Early warning systems	2

4.2.1 Long term ecological monitoring

The participants indicated that the current marine water quality monitoring programme assists in providing environment quality data in relation to water and sediments in the ports. The respondents had a common voice regarding the monitoring protocol, where they indicated that monitoring is conducted bi-annually, summer and winter. Furthermore, the monitoring of the water and sediment quality is conducted to determine the status quo of the ports ecosystem in relation to the monitoring guidelines.

CSIR interviewee 2 (2019, personal communication, 24 April) stated that *"The monitoring for the ports we do it for seven reports around the country and we look at water quality, sediment quality and bioaccumulation in muscles. We have selected stations on the port -like areas that we think are of concern, sediment assessments and bioaccumulation that we do in muscles, so all the water samples we look at the general physical, chemical parameters with salinity, temperature and pH and salinity gives a good indication of the fresh water coming into the systems which is something that impacts on quality of the water. That's not from port activities but from external sources, but influences the port and also look at the concentration levels as a proxy for phytoplankton, biomass and that allows us to tackle if there is any blooms or anything caused by excessive nutrients in ports and sediments. The metals looks at organic chemicals, sediment, and for the muscles, we also look at organic chemicals and metals not look at metals in the water, so we basically just had to make sure that the monitoring is done and that guidelines are met and that the environmental managers have some idea on what is happening in their ports and some recommendations that we think they need to consider during all monitoring exercises".*

4.2.2 Sediment assessment

Seven out of eight South African commercial seaports are in possession of the dredging permit, with the exception of the port of Saldanha. The respondents spoke with a unanimous voice that sediment assessments are an integral part of the port operations; as the safe navigation of the vessels depend on the desired depth of the channel. As a result, sediment assessments are conducted to monitor for any anomalies that might impact on the dumping permit requirements as per the DEA dredging permit conditions issued under chapter 8 of the ICM Act.

TNPA interviewee 4 (2019, personal communication, 30 April) indicated that *"My particular interest has been the sediments because of the disposal and dumping requirements to ensure*

that sediments are safe enough to be disposed of and in such a way that we are able to get a dumping permit from the Department of Environmental Affairs".

Moreover, TNPA interviewee 4 (2019, personal communication, 30 April) stated that *"Whatever you take out from the silt canal now you cannot dump it out as normal as you would from the rest of the port and the word mostly used is, it's contaminated and how you dispose of it you would have to take extra measures from the normal disposal process".*

The Port of Durban, has had a long standing permit condition that states "*The applicant shall implement measures within and beyond the validity period of this permit to reduce the concentration of Cadmium and Copper detected in the sediments from the Silt Canal". Permit No. 07/2018 Port of Durban.*

Furthermore, the chemical quality of the various sized fractions of the sediment would dictate the method of disposal; for example, the silts would accumulate the heavy metals and would be the hazardous material requiring the most stringent controls.

4.2.3 Legislative mandate

The responses from SAMSA revealed that their mandate is from the SAMSA Act of 1998. SAMSA responsibilities are (i) safety of life and property at sea (ii) prevent and combat pollution from ships (iii) promote maritime interest. It was indicated that their interest lies solely on board the vessels.

SAMSA interviewee 2 (2019, personal communication, 10 May) stated that *"Our involvement only ends on the ship. Water quality and all that we don't get involved it is the delegation of the Department of Environmental Affairs".*

Under normal operating conditions SAMSA is empowered to undertake port state inspections of vessels as per the Abuja and Indian Ocean Memorandum of Understanding on port state control. During an emergency pollution incident, the responsibility to clean up is that of the National Ports Authority within the port boundaries and externally DEA takes over.

SAMSA interviewee 1 (2019, personal communication, 30 April) stated that *"we can impose fines, to vessels that pollute water, let's use oil as an example quite often find pollution from the ship to the water, if found in contravention, can impose fines to a maximum of R500 000 , which is not very high".*

The Department of Environmental Affairs is the national legislator and is empowered to exercise an oversight role, through compliance audits. The Department has to determine if the harbour is compliant and prosecute contraventions of the law. It is therefore incumbent on the harbour to monitor its activities, including liquid discharges to the bay. The monitoring data should then be submitted to the Department of Environmental Affairs for reporting purposes.

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"…It is a legislation requirement to apply for a dredging permit at the department of environmental Affairs".*

4.2.4 Early warning systems

Interestingly, the study revealed that 2 of the 14 respondents indicated that, data from the monitoring programme has been used as an early warning system. It is important to note that, the majority of the respondents indicated that, the primary objective for the monitoring programme is to assist TNPA to manage port operations for the purposes of long term ecological sustainability.

TNPA interviewee 2 (2019, personal communication, 2 May) explained that for the Port of Durban data are used in an early warning system for "*... Symptomatic signs of incidents such as fish kills. So in those cases, we know that the system is currently stressed and investigations to be held in terms of what the problem is, also in terms of monitoring interventions from that perspective".*

TNPA interviewee 10 (2019, personal communication, 16 May) also stated that "*I have responded by drawing up specification for a company that we can contract so that it doesn't become a process of as and when, because we also noticed that we get taken advantage of because they know that we don't have a contract and we get charged high amounts and we also acknowledged that emergency spillages are expected in the port due to the nature of operations, so why not prepare for such and apply a proactive approach".*

In contrast to TNPA interviewee 10 , TNPA interviewee 4 (2019, personal communication, 30 April) indicated that*"…what we need to do to make sure that we have a port in the next 40 years, I want my kids to work in the port and it pains all of us because we even see the effects of global warming that we are experiencing, but now it's almost like we are reactive to whatever occurrences and we are not moving in a fast enough pace to ensure that our activities are supportive of the environment".*

4.3 Contributing factors to marine water quality

Contributors to poor marine water quality range from internal to anthropogenic activities. With the majority of the ports being at the receiving end of the storm water run-off, canalised rivers, and sewage spills. Bylaws and legislation enforcement is imperative. Through the ISO 14001 system, the ports are striving towards continuous improvement and regular enforcement to monitor port activities. Environmental consultative forums are in place to continuously engage with the port users. Interviewees were asked, what the most contributing factors to water quality are. The responses were analysed and Table 4.2 show the main themes that were recorded frequently.

Table 4.2: Themes on contributors to poor marine water quality

Focus of themes	**No. of respondents**
External sources	12
Dry dock/ ship repair operations	10
Internal port operations	8
Oil Spills	8
Hull cleaning	8
Projects	6
Heavy rains	3
Formal and informal activities	2
Plastic pollution	2

4.3.1 External sources

A number of external sources have been identified as river canals, storm water drains, sewage spills to poor waste management. With the Port of Durban surrounded by 3 river canals: Amanzimnyama, Umhlathuzana and Umbilo, as well as 57 storm water outlets; East London is engulfed with the constant sewage spills; and the Salt River canal from the City of Cape Town deposits its pollutants into the port waters. The ports are faced with realities of dealing with the transformed environments surrounding the ports. External pollution sources are regulated by the national and local authorities. For example, in Durban the control mechanisms for various pollution sources are the responsibility of the eThekwini Municipality.

TNPA interviewee 2 (2019, personal communication, 2 May) stated that *"The lack of facilities to actually dispose of one's waste and the inaccessibility of waste collection vehicles and trucks. So for instance, many of the informal settlements don't have internal roads which prevent waste trucks from collecting the waste and consequently this leads to waste ending up in river streams".*

In the case of the silt canal in the southern limb of the Durban Bay, it was found that the oxygen concentration of the water column was depleted and the sediments had an excessively high metal concentration. It was deduced that the sediment was depleting the water column. The source of pollution was found to be natural sources, industrial and sewage contamination.

TNPA interviewee 3 (2019, personal communication, 6 May) stated that and TNPA interviewee 7 (2019, personal communication, 15 May) stated that *"From time to time the port experience sewage spillages due to malfunctioning municipal pump stations".*

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"This does not mean that port operations are free from affecting the water quality, although it does but not to the level of Salt River and storm water canal. For instance, during winter season, Cape Town usually experience heavy rains which deposit most of the vegetation from the river channels to the port waters and with sediment that comes along, this includes the storm water canal for eroded sediment".*

This indicates that the inefficient management of the municipal infrastructure has an impact on marine water quality as well as natural sources.

4.3.2 Dry-dock operations

The majority of the respondents from the ports alluded to the fact that heavy metal concentrations are associated with the ship repair facilities. It is also important to highlight that, ship repair activities are managed internally and externally.

TNPA interviewee 3 (2019, personal communication, 6 May) stated that *"Internal port operations especially at our dry-dock, the CSIR report show that the dry dock is heavily impacted because of cargo handling and vessel repairs that are being done at the dry dock facility".*

TNPA interviewee 1 (2019, personal communication, 12 April) stated that "*The ancient design of the dry-dock facilities are not conducive to proper clean-up as the design allows the contaminants to settle in".*

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"….the dry docks during hull cleaning also does affect the water quality".*

In contrast to TNPA interviewee 8, TNPA interviewee 5 (2019, personal communication, 2 May) stated that *"…dry dock operations if properly controlled it shouldn't be a problem. I trust that people managing the dock follow the proper procedures inside dry-dock is controlled, clean the under keel of the vessel, contained and dump correctly. Transnet has good processes the issue might be the enforcement. Harbour Master is responsible for checking that these processes are followed on ad hoc basis".*

4.3.3 Internal port operations

Respondents indicated that internal port activities contribute to marine water quality issues due to cargo spillages. Many examples were sighted such as, shot blasting, the dry dock area, the off-loading and loading facilities (particularly in the dry bulk precincts) housekeeping along the wharfs, yacht club vessels, regular oil pollution from operations, ship slops and ballast water discharges.

TNPA interviewee 5 (2019, personal communication, 2 May) stated that *"the factors that lead to contamination in the port are quite wide. First of all we manage the vessels, from vessels themselves, need to be maintained in such a way that they don't have things like oil coming out from the vessel. The Harbour Master plays a critical role in making sure that the port is taken care of, for instance, the pilots go on-board the vessel and become the eyes of the Port Authority, they check for any visible defects on vessels".*

It is important to highlight that, there are no treatment or reception facilities in the harbour for ballast, galley waste or ships slops. However licensed service providers provide this service through licensed vessel agents.

TNPA interviewee 7 (2019, personal communication, 15 May) stated that "*With respect to dry bulk commodities, the Port of Port Elizabeth has gone as far as engaging the commodities owners to manage the cargo spills and the cargo owners present the mitigation measures at the dry bulk forum".*

The respondents stated that the importance of the Transnet value chain to engage the commodity owners in so far as managing the cargo spills and poor housekeeping along the wharf side is of equal importance.

SAMSA interviewee 1 (2019, personal communication, 30 April) stated that *"Saldahna discharges about approximately 9 million cubes per annum, Richards Bay about 18 million cubes discharge per annum into the bay. The recently adopted Ballast Water Convections came into effect in September 2017. However, South Africa doesn't have the ballast water regulations as yet, SAMSA need to get the regulations to enforce. The Department of Transport indicated that it is work - in - progress and that is one area that can compromise quality of the water".*

TNPA interviewee 6 (2019, personal communication, 10 May) stated that *"Vessels are required to submit documents indicating where the water balance exchange was done before they entered South African waters, 200 nautical miles".*

TNPA interviewee 4 (2019, personal communication, 30 April) stated that *"…de- ballasting from the vessels, we are very much aware that whenever a vessel has to be balanced it has to take ballast water. However, as a country we have to worry about the alien invasive species that end up creating their own families and threatening the indigenous marine species. It affects the subsistence fishermen who relies on fishing for his well-being and I was talking to a diver one of the days and he was mentioning that there used to be lots of fish in the harbour but now the numbers have declined. What has happened? I could not answer that, but it made me sit back and say: what are we doing in the end, are we doing enough really to know to actually say we are concerned about the environment and we can even be stricter".*

In line with the Harbour Rules, the Marine Safety Inspectors are to exercise an oversight role in managing the ballast water discharge in the harbour.

TNPA interviewee 4 (2019, personal communication, 30 April) indicated that *"… enforcement of ballast water management has been there for the longest time and vessels are supposed to have machinery on board that clean the ballast water before it even leaves the vessel in such a way that it has killed and a large number of those alien species and it is safe enough to be discharged. But now, what we have, is paper-based. We just ask the vessel which ports have you been to and where did you take your ballast water from. We are satisfied with it. They don't even go beyond to ensure that they do have a treatment plant on board to treat the ballast water. We just assume that if we know where the vessel has been, i.e. Australia, then assume*

that it is enough. And again, that way will require SAMSA because they have the authority to get on board the vessel, go to the vessel's engine rooms and paper work to ascertain that the right machinery is used and does what it's supposed to be doing".

TNPA interviewee 9 (2019, personal communication, 21 May) indicated "*Activities from Port operations including shipping, dredging, ballast water discharges, cargo spillages etc*." do contribute to marine water quality.

Notably, the port relies on the ballast water reports from a vessel. SAMSA is yet to enforce this practice due to the fact that ballast water regulations are not yet in force.

4.3.4 Oil Spills

Respondents indicated that, due to the nature of the port operations, incidental spills may occur. When they do occur, emergency response plans are to be followed to mitigate against impacts on marine life.

SAMSA interviewee 2 (2019, personal communication, 10 May) stated that *"What normally happens is that, when a bunker barge wants to supply fuel– our role is to inspect that vessel – if it is fit for purpose, thereafter provide clearance. Moreover, we look at the vessels oil spill contingency plans in line with the national contingency plan".*

4.3.5 Hull cleaning

Hull cleaning of ships in the ports is bound to happen and this is regulated by the MARPOL Annex VI. Prevention of air pollution from ships requires ships to clean hull and propeller in order to reduce the drag and ultimately, results in less fuel consumption. South African seaports have embarked on a hull cleaning licencing process.

SAMSA interviewee 1 (2019, personal communication, 30 April) stated that *"In-water hull cleaning activities can compromise the quality of the marine water in the water columns if not properly controlled".*

SAMSA interviewee 1 (2019, personal communication, 30 April) stated that *"Again South Africa has agreed to MARPOL Annex VI but doesn't have promulgated Regulations as yet".*

TNPA interviewee 4 (2019, personal communication, 30 April) indicated that *"I think at this point in time, the permits that we issue for each vessel that needs to be hull cleaned, the specific measurements are in place to ensure that again you are given a certain space to work under and before any work starts, the port marine safety inspectors inspect to ensure that the type of*

machinery that is used is the one that is acceptable or that is approved with the proof of its filtration system, ensuring that the safety measures are in place, ensuring that whatever was scraped out of the vessel there is a disposal certificate to say it was disposed of correctly. I think for us, it gives a small piece of comfort when we know that proper procedures were followed".

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"Furthermore, the dry docks during hull cleaning also does affect the water quality.*

SAMSA interviewee 2 (2019, personal communication, 10 May) stated that *"As SAMSA we trust that TNPA has the correct controls in place to monitor hull cleaning activities".*

4.3.6 Infrastructure capital projects

Respondents indicated that there are opportunities to improve the current status quo through the New Business Development projects. Environmental considerations should be catered for in the Project Life Cycle stage.

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"The port operations also affects the water quality due to the activities that are conducted in the port environment. There has been infrastructural development in the port, during the construction process, contaminated surface runoff is deposited in the port waters".*

TNPA interviewee 7 (2019, personal communication, 15 May) stated that *"…in the Port of Port Elizabeth, the Slipway upgrade in terms of the engineering controls was informed by the constant poor water quality emanating from the CSIR data".*

4.3.7 Heavy rains

In recent years, the ports have been experiencing stormwater surges associated with the heavy downpour that brings along vegetation logs, foreign objects, plastics, etc. into the port waters. For example, the Durban harbour in the month of April 2019 was engulfed by debris and unknown foreign material that resulted in operational delays and water quality impairment.

Notably, the Port of Durban is not the only port that has experienced such, realities of climate change. Furthermore, *TNPA interviewee 8 (2019, personal communication, 20 May) stated that "Cape Town usually experience heavy rains which deposit most of the vegetation from the river channels to the port waters and with sediment that comes along, this include the storm*

water canal for eroded sediment. These do not only pollute port waters but also accumulate sediment that if not dredged it becomes an obstruction for vessels to come in the port".

4.3.8 Formal and informal activities

Catchment management and municipal bylaws enforcement is a critical component in managing formal and informal activities upstream from the port environments.

TNPA interviewee 2 (2019, personal communication, 2 May) stated that *"...formal and informal activities across various land uses, i.e. residential, industrial, informal and commercial spaces are one of the primary sources of pollutants which make its way into the port. The informal sector and the industrial sector within the catchment range from motor mechanics and vehicle stripping in and around water courses and informal housing lack waste management services and are unlawfully dumping a variety of chemicals, hydrocarbons, and used oil into the water courses. The lack of enforcement and monitoring regarding effluent discharges from industrial processes are other sources of pollution that need to be monitored on a regular basis to ensure that industries are operating within the licenced conditions and legal parameters under which they need to operate".*

TNPA interviewee 2 (2019, personal communication, 2 May) stated that *"...Our interventions range from engagements with the local authority and that brings sanity in terms of trying to contain point source pollution and sources of pollution in the catchment".*

4.3.9 Plastic pollution

One of the participants described the Corporate Social Initiatives (CSI) that the port has embarked on with respect to creating marine pollution awareness amongst the community and the schools.

TNPA interviewee 10 (2019, personal communication, 16 May) stated that *"In the port of Mossel Bay, plastic pollution is largely introduced by heavy winds and these plastics end up in the water, we have then introduced skip nets to minimise plastic scattering. Through the CSI we have engaged schools and children to create awareness about the impact of plastic on the marine environment".*

The interface meetings should play a crucial role in dealing with external sources of pollution. Notwithstanding the Municipal and Provincial Coastal Committees where relevant institutions are expected to report on the status of the Estuarine Management Plan deliverables.

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"CSIR data may be used as a baseline. However, the actual impact on the port environment is still unknown, for instance the impact of plastics, the impact of hull cleaning operations on the living organisms within the port environment".*

4.4 Marine water quality data impact on pollution prevention strategies

The sentiments shared about this theme are that, knowledge from the monitoring reports is there, however, the ports haven't moved fast enough to implement prevention strategies. For example, in the Port of Richards Bay, cargo handling operations and old infrastructure are the biggest contributors to poor water quality. Another example is that of Iron Ore concentration levels in Saldanha and their potential impact on aquaculture farms. Again, data is there but we are not moving fast enough to manage the situation. Interviewees were asked how the monitoring data has impacted on pollution prevention strategies for the ports. The responses were analysed and Table 4.3 show the main themes that were recorded frequently.

In a nutshell, the two common shared sentiments were (1) legislative requirements and (2) decision making enabler.

Table 4.3: Themes on impact of pollution prevention strategies

Focus of themes	**No. of respondents**
Legislative requirement	9
Decision making	5

4.4.1 Legislative requirement

South African seaports operates under the auspices of the National Ports Act (RSA, 2005) and other international legislation that the country subscribes to. The ports are required by law to operate within the legal limits, as such, environmental monitoring is a continuous process through the ISO 14001.

SAMSA interviewee 1 (2019, personal communication, 30 April) stated that *"From the international perspective, South Africa is signatory to the IMO and forms part of the pilot countries in MARPOL annex VI, in line with the Glomeep project. The rationale is that when a vessel is coming to South Africa, the country wants to make sure that vessel is burning proper*

fuel (cleaner fuel). Also studies alluded to the communities close to the port being exposed to climate change and emissions effects".

TNPA interviewee 5 (2019, personal communication, 2 May) stated that *"I believe that South Africa as a country is well equipped, the challenges is regarding the Delegation of Authority when it comes to signing and execution. We need to be organised as the maritime industry. There is a need for a forum between TNPA, DoT, SAMSA and DEA to come up with the strategies for implementation, monitoring and reporting of the IMO adopted treaties".*

4.4.2 Decision making

The long term ecological monitoring for the ports was conducted to facilitate the dialogue between the environment team, management and port users. Reason being, environment issues tend to be on the low priority list, due to the fact that they are financially intensive and sometimes not favourable to the port user.

TNPA interviewee 3 (2019, personal communication, 6 May) stated that for instance, one respondent had this to say, *"DoT requires the port to provide certain areas to the community for fishing and this was a strategic project for the Port of East London. The monitoring data has assisted in identifying suitable areas for fishing in the port and not just to fish anywhere".*

TNPA interviewee 6 (2019, personal communication, 10 May) stated that *"the monitoring reports help to understand the situation in the port in order to put in measures to address/ reduce the impact. Water quality monitoring help us to identify problematic areas and prioritise them when developing strategies for improvement. For instance, if water quality is very poor in dry bulk berths, we use that report to motivate to our seniors to invest in best practices and to ensure compliance with duty of care and remediation of environmental damage".*

In contrast to TNPA interviewee 3 and TNPA interviewee 6, TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"The monitoring data is partially utilised at the port. The main issue that it has been successfully used for is dredging permits. It is a legislation requirement to apply for a dredging permit at the Department of Environmental Affairs. Due to this, it is compulsory to submit a water quality report to the Department of Environmental Affairs for approval. In this manner certain objectives are achieved through these reports".* Furthermore, TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"Furthermore, previous reports indicated an e-coli contamination. The environmental*

specialist conducted an investigation. It was discovered that there was a leak in a drainage pipe connected to the main sewer. The findings were directed to the relevant department, i.e. engineering, and the matter was resolved. What assisted for quick response was a complaint from a tenant which added pressure to the management. The matter was given proper attention. There are instances where the relevant departments will be notified without any action taking place or passing the buck. Lack of ownership sometimes becomes a challenge. Furthermore, enforcement is lacking".

Notably, TNPA interviewee 9 (2019, personal communication, 21 May) stated that "*At the Port of Saldanha, a gap was identified though an internal audit that the data from the State of the Bay reports are not being interrogated to comprehensively determine the trends of the water quality in order to implement control strategies to improve the marine water quality within the port boundaries".*

From the discussion above, it is clear that TNPA still has a gap to bridge in terms of effectively utilising the monitoring data from the reports produced by the service providers for decision making purposes.

4.5 Effectiveness of implemented pollution prevention strategies

Respondents indicated that various pollution prevention strategies are in place, however, it is the effectiveness that is questionable. Engineering, physical barriers and administrative were some of the controls highlighted. Recently, the ports are looking at sustainable ways of managing the port operations to circumvent environmental degradation. The recently Gazetted Estuarine Management Plan for the Port of East London as well as the existing Port of Durban Estuarine Management Plan are some of the tools that the Port Authority is implementing to prevent and minimize pollution from both internal and external sources. Interviewees were asked to outline the marine pollution prevention strategies' implemented in the past years and how they assisted in the management of marine water quality. The responses were analysed and Table 4.4 show the main themes that were recorded frequently.

Table 4.4: Themes on pollution prevention strategies

Focus of themes	**No. of respondents**
Administrative controls	8
Engineering controls	3

Physical barriers	3

4.5.1 Administrative controls

The ports are equipped with a vast number of legislative frameworks that the port users, terminal operators and international vessels are to comply with. However, the enforcement seems to be a challenge.

TNPA interviewee 4 (2019, personal communication, 30 April) indicated that "*…views are that we have all these administrative controls, so we looked good on paper".*

TNPA interviewee 1 (2019, personal communication, 12 April) stated that "*… with regard to the IMO regulations, sewage treatment on-board the vessels, how sure are we that the vessels are compliant".*

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"Any discharge from the vessels in relation to sewage related matters more often than not will be denied".*

TNPA interviewee 9 (2019, personal communication, 21 May) indicated "*Ballast Water Management – Various controls have been implemented by the Harbour Master's office to ensure that ballast water discharges are controlled in order to minimise the introduction of marine alien species".* She further indicated that a downward trend can be noted at some of the sampling sites since 2010.

TNPA interviewee 4 (2019, personal communication, 30 April) indicated that *"It's not working in our favour, to ignore the current issues. On the business front, yes the vessels are calling to the port and we just continue as normal, but then what are we doing to the environment, is it sustainable enough to still have a port in the next 40 years?"*

SAMSA interviewee 2 (2019, personal communication, 10 May) stated that *"As SAMSA we have issued marine notices to create awareness".*

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"Annual marine week clean-up programmes where more often plastic bottles, fishing nets etc. that compromises the quality of the water are retrieved".*

4.5.2 Engineering controls

The respondents indicated that now the opportunity exists, where the project teams are appointed upfront to develop inclusive project specifications and this allows for environmental concept, design and operation to be factored in at an early stage. TNPA interviewee 1 (2019, personal communication, 12 April) stated that *"the Ports are starting to talk about ecological engineering solutions, such as nature retention to manage flooding".*

4.5.3 Physical barriers

Respondents indicated that physical barriers do work to some extent, but they are dependent on continuous monitoring and maintenance. The Port of Durban recently explored the use of permanent containment booms through the Source to Sea project (DEA, 2018) to minimise solid waste entering the port waters.

TNPA interviewee 2 (2019, personal communication, 2 May) stated that *"...in the catchment areas we have implemented things like the Edwin swales weir, which assists in minimising some of the solid waste and oils from coming down to the port. Moreover, we also purchased and installed floating booms at the silt canal".*

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"The placement of grit structures at the storm water outlet assisted in reducing the big objects from entering port waters, although small particles continue to pass through. Then all the trapped objects are being deposited of in the landfill site".*

4.6 Marine water quality management additional recommendations

The respondents indicated that, the ports should not work in isolation to manage the sources of pollution. The majority of the ports are located in developed environments. As a result, there is a need to partner with local municipalities, industries, and the public to manage the environment responsibly. Aspects such as awareness, oversight, partnership and capacity building are key to continuous improvement. Interviewees were asked to outline additional recommendations to improve marine water quality management in the ports. The responses were analysed and Table 4.5 show the main themes that were recorded frequently.

Table 4.5: Marine water quality recommendations

Focus of themes	No. of respondents
Awareness	8
Partnerships	8
Enforcement and oversight	4
Capacity Building	4
Participation at national forums	2

4.6.1 Awareness

The respondents indicated that, there is a need to increase awareness and publicise the monitoring data results, especially where the anthropogenic factors are prevalent. Awareness should start within the organisation, so that when we go out we speak with a unanimous voice.

CSIR interviewee 2 (2019, personal communication, 24 April) stated that *"I think providing education, that can overcome anything by teaching people. What can be achieved? How we can achieve it? What is best for people and what is best for the environment? You know there will always be a middle ground that you can find".*

TNPA interviewee 3 (2019, personal communication, 6 May) stated that *"…do awareness to employees and tenants where faecal coliform is high and share with the fishermen, divers, marine shore hand as well, as they get impacted when the E.coli levels are high".*

TNPA interviewee 6 (2019, personal communication, 10 May) stated that *"Conduct more awareness's to tenants and employees regarding impacts on marine water. Ensuring marine water quality should be the responsibility of everyone i.e. tenants, TNPA, and the community at large".*

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"More awareness on activities that has a potential to contribute negatively to the port water".*

4.6.2 Partnerships

From the responses received, there is a strong belief that partnership with the municipalities and research institutions can assist the ports in dealing with the factors influencing marine water quality.

CSIR interviewee 2 (2019, personal communication, 24 April) stated that *"I would definitely encourage the ports to work with municipalities and it would be like a costly project and stuff, but you need to look at what is actually coming into the port and how it is affecting the water quality".*

TNPA interviewee 3 (2019, personal communication, 6 May) stated that *"There is also sampling done by the University of Fort Hare for research purposes- started last year, not yet shared the report with the port, as the report is not final as yet. I'm planning to compare the findings with those of the CSIR and plan to deal with the issues in a broader way".*

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"…research collaboration with marine department at the Cape Town University of Technology and joint operation with other stakeholders outside and within the port".*

TNPA interviewee 3 (2019, personal communication, 6 May) stated that *"Need to emphasise, honestly the management of marine water quality need all the stakeholders not just the environmental science but all relevant stakeholders are required to manage the issue of marine water quality. I have requested the Port Manager to engage the Municipal Manager as the issues go beyond environmental. We can address some at Business Continuity Management with water and sanitation guys but more needs to be done at the executive level to address social issues and at the political level as well".*

TNPA interviewee 4 (2019, personal communication, 30 April) indicated that *"…We need to look at the port in its entirety, not just in certain sections and making sure that our customers are with us in ensuring a cleaner port".*

4.6.3 Enforcement and oversight

The ports have a role to play with respect to the implementation of the Ports Act. The ports issue licences for waste management, bunker operations and terminal operator licences. As a result, the port is expected to exercise an oversight role through audits and routine inspections.

The respondents felt that, the ports have a yard stick, but it is not utilised correctly.

TNPA interviewee 10 (2019, personal communication, 16 May) stated that *"….improve oversight role, vessels dock in the port, they spill and leave. There are no strict rules for reprimanding them. When it comes to the polluter pays, what is the problem? Why are we not enforcing this principle? I think if we start touching the pockets they will realise that*

operational controls are important to minimise environmental impacts. I think we should tightened up our oversight mandate especially in environmental management".

TNPA interviewee 2 (2019, personal communication, 2 May) stated that *"Department of Water Affairs is under-resourced at the moment, and they don't have functional catchment management forums. They don't have the capacity to actually do what they are supposed to do. Consequently, they don't have the capacity to actually follow up on the actions that are required to address the pollution sources in the catchment. Local government has a critical role to play, i.e. the eThekwini Municipality, the Metropolitan strategy, which has a sizeable budget. Unfortunately it seems to be working in silos rather than having a combined approach because things like waste management, you need to have the various sectors together, with enforcement to work together".*

4.6.4 Capacity building

Respondents indicated that capacity building to manage the dynamics of the marine environments is a critical success factor.

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"The ports environmental officer, or specialist to be trained on how to associate the operations with water quality results".*

TNPA interviewee 6 (2019, personal communication, 10 May) stated that *"Employment of pollution management inspectors will assist in monitoring and enforcement, as we are currently under-resourced".*

SAMSA interviewee 1 (2019, personal communication, 30 April) stated that *"...the issue is domesticating these regulations, the process takes too long. The issue is both process and capacity".*

4.6.5 Participation at national forums

Two respondents had a common voice regarding TNPA's participation at the National Dumping at Sea forum.

TNPA interviewee 8 (2019, personal communication, 20 May) stated that *"...National Dumping at Sea Water forum which is lead both by SAMSA and DEA. Lack of consistency in attending this forum from Ports contributes negatively. These are some of the platforms that*

may be influential in contributing to decision making and way forward for the ports in improving the water quality in line with national requirements".

SAMSA interviewee 1 (2019, personal communication, 30 April) stated that *"... Basically, TNPA needs to participate at the Dumping at Sea Forum chaired by DEA where SAMSA is also in attendance".*

TNPA needs to attend these meetings as they are impacted by the decisions taken at these forums due to the Dumping at Sea permits that TNPA applies for annually.

4.7 Conclusion

This chapter analysed the interviewee responses in line with the major themes and codes that emerged during the interviews. The findings together with the literature information are further discussed in the succeeding chapter.

CHAPTER FIVE
DISCUSSION

5.1 Introduction

This chapter seeks to discuss the key findings of this study which reflect on the dynamics of marine water quality management in South African seaports. The findings are discussed relative to existing literature and studies on marine water quality practices. This chapter is structured as follows. Section 5.2 discusses marine water quality management practices. Section 5.3 discusses contributing factors to marine water quality. Section 5.4 discusses marine water quality data impact on pollution prevention strategies. Section 5.5 discusses effectiveness of implemented pollution prevention strategies. Section 5.6 discusses additional recommendations on marine water quality management. Section 5.7 concludes.

5.2 Marine water quality management practices

South African seaports operate under the auspices of the National Ports Act (RSA, 2005) and other international legislation that the country subscribes to, refer to appendix 1 for summary of legislation relevant on marine water quality. The ports are required by law to operate within the legal limits, as such, environmental monitoring is a continuous process through the ISO 14001(Edwards, 2001).

With respect to marine water quality management practices in the ports, interviewees representing all eight ports indicated that the long term ecological monitoring is conducted bi-annually, both in summer and winter, and the annual monitoring reports are produced. TNPA has implemented Long-Term Ecological Monitoring Programme in seven South African seaports. The aim of the monitoring is to understand the state of the aquatic environment in each port, to identify challenges facing these environments and how these may affect port operations, and to identify possible solutions to the challenges (CSIR, 2013).

Conversely, in the Port of Saldanha, marine water quality is conducted by the Saldanha Bay Water Quality Forum Trust which feeds into the annual State of the Saldanha Bay Report. A series of scientific monitoring are performed, including water quality (faecal coliform, temperature, oxygen and pH), sediment quality (trace metals, hydrocarbons, total organic carbon (TOC) and nitrogen), benthic macro fauna, alien species, surf zone fish, and rocky intertidal macro fauna (Clark et al., 2016).

Furthermore, it is indicated that water quality can be defined in terms of the chemical, physical and biological content of water (CSIR, 2013; 2016). Notably, CSIR (2013; 2016) defines water quality as a term used to describe the ability of water to support various beneficial designated uses, such as, marine plant, animal life and the use of water by humans for recreational purposes. CSIR (2016, p.1) state that "the monitoring programme comprises summer and winter surveys that differ in the scope of physical, chemical and biological indicators monitored and environmental media in which they are monitored; the summer survey focuses on water quality only while the winter survey focuses on water quality, sediment quality, benthic macro faunal community status and bioaccumulation of contaminants by mussels". McClanahan (1988) indicate that seasonal changes control various ecological processes. Moreover, while seasonality of the wet and dry periods is a well-documented phenomenon for East Africa terrestrial environments, seasonality in marine environments is less understood (McClanahan, 1988).

Ten out of 14 respondents stated that the marine water quality management practices are inclusive of sediment assessments as well. This is due to the fact that ports are required to monitor for concentration of contaminants such as tributyltin, metals, including cadmium and mercury in the sediments in parts of the ports, as in certain ports such as in the Port of Cape Town and the Port of Durban is high enough to be included in the National Action List, which the Department of Environmental Affairs uses to determine if sediment dredged in South African seaports is suitable for sea disposal or alternatively explore other disposal mechanisms (CSIR, 2016a; 2017b).

Legislative mandate came out very strongly, as nine out of fourteen respondents indicated that the long-term ecological monitoring results assist the seven ports to apply for dredging permits to the Department of Environmental Affairs (Oceans and Coasts). Interviewees statements in relation to dredging permits are substantiated by CSIR (2017, p. 82) as it is stated that "the findings of other monitoring performed in the ports must be considered in conjunction with the findings of the Long-Term Ecological Monitoring Programme, for example, sediment is collected in the ports and analysed for its grain size, total organic content and metal concentrations for the purpose of a maintenance dredging permit application to the Department of Environmental Affairs". The combined data for the maintenance dredging and the Long-Term Ecological Monitoring Programme programmes will provide a more comprehensive understanding of the water and sediment quality in the ports.

Two of the respondents indicated that data is used as an early warning system and data is used for symptomatic occurrences respectively. This is an interesting aspect as many respondents indicated that data is used for trend analysis.

The environmental impacts associated with the port operations vary dependent on the port surroundings. The CSIR long term ecological monitoring programme indicates that sediments located near canalised rivers, surface storm water runoff are susceptible to poor conditions (CSIR 2017). For example, the Port of East London is located in the Buffalo River Estuary, the port is greatly impacted by urban activities such as solid waste, storm water runoff and sewage, just to mention a few (DEA, 2018). The Port of Durban is in the same predicament as three rivers discharge into the port (DEA, 2016a). From time to time unknown source of oil spills land into the port waters and most of the time TNPA has to facilitate the clean-up. Though it is necessary for the ports to be afforded the same level of ecological protection which is the same as those of anthropogenic unimpaired coastal systems, the reality is that environment quality in most ports is expected to be impaired due to day to day operations. Maintaining the same environment quality in ports unspoiled is challenging or at the very least expensive to maintain (CSIR, 2013).

The responses from SAMSA revealed that their mandate is from the SAMSA Act (RSA, 1998c). SAMSA responsibilities are (i) safety of life and property at sea (ii) prevent and combat pollution from ships (iii) promote maritime interest. It was indicated that their interest lies solely on board the vessels. Under normal operating conditions SAMSA is empowered to undertake port state inspections of vessels as per the Abuja and Indian Ocean Memorandum of Understanding on port state control. During an emergency pollution incident, the responsibility to clean up is that of the Ports Authority within the port boundaries and externally DEA takes over.

The Department of Environmental Affairs is the national legislator and is empowered to exercise an oversight role, through compliance audits. The Department has to determine if the harbour is compliant and prosecute contraventions of the law. It is therefore incumbent on the harbour to monitor its activities, including liquid discharges to the bay. The monitoring data should then be submitted to the Department of Environmental Affairs for reporting purposes (DEA, 2014a).

The long term ecological monitoring for the ports was conducted to facilitate the dialogue between the environment team, management and port users. Reason being, environment issues

tend to take a back seat as they are financially intensive and sometimes not favourable to the port user. Two of the respondents indicated that data from the monitoring programme has been used as an early warning system. The majority of the respondents indicated that the primary objective for the monitoring programme is to assist TNPA to manage port operations for the purposes of long term ecological sustainability.

5.3 Contributing factors to marine water quality

A number of external sources that contribute to marine water quality were identified by interviewees. Interviewees indicated that contributing factors to marine water quality are enormous. DEA (2018d, p. 43) indicate that the contributing factors range from "anthropogenic sources such as raw sewage (municipal waste), storm water run-off (litter, debris, oil and grease), accidental oil spills (oil and grease) and illegal dumping of ship refuse". These contributing factors were evident from the interviews conducted as twelve out of fourteen respondents indicated that external sources ranged from land based activities, discharges from storm water outlets, canalised rivers leading into the ports, sewage spills due to malfunctioning municipal pump stations and illegal dumping of waste.

The Port of Durban is surrounded by three river canals: Amanzimnyama, Umhlathuzana and Umbilo, as well as 57 storm water outlets (CSIR, 2013). East London is engulfed with the constant sewage spills, and the Salt River canal from the City of Cape Town deposits its pollutants into the port waters. The ports are faced with realities of dealing with the transformed environments surrounding the ports. External pollution sources are regulated by the national and local authorities. For example, in Durban the control mechanisms for various pollution sources are the responsibility of the eThekwini Municipality.

In the case of the silt canal in the southern limb of the Durban Bay, it was found that the oxygen concentration of the water column was depleted and the sediments had an excessively high metal concentration (CSIR, 2013). It was deduced that the sediment was depleting the water column. The source of pollution was found to be natural sources, industrial and sewage contamination (CSIR, 2016). This indicates that the inefficient management of the municipal infrastructure has an impact on marine water quality as well as natural sources.

Sewage was discovered flowing into the port from the eThekwini Municipality's sewer reticulation system. As a consequence, TNPA implemented a ban on all fishing, commercial diving, and other marine activities in the Port of Durban. The ban was provisionally lifted in early June 2019. Rall (2019, p. 1) indicate that "environmental organisations believe the

contaminated water poses a serious threat to both the marine life at the harbour and those who fish alongside the marina".

DEA (2018, p. 2) indicate that "80% of all marine pollution originates from sources on land". This is further substantiated by Derraik (2002, p. 842) as he states that "human activities are responsible for a major decline of the world's biological diversity". Clark et al., (2014, p. 39) state that "disposal of wastewater is a major problem in Saldanha, and much of it finds its way into the Bay as partially treated sewage, storm water, industrial effluent and ballast water". Clark et al., (2014, p. 40) state that, "sewage discharge is disputably the most important waste product that is discharged into Saldanha Bay in terms of its continuous environmental impact". Undoubtedly, there remains considerable work to be done in managing large volumes of effluent discharged into the ports that is clearly non complaint with the existing effluent quality standards.

Eight out of fourteen respondents indicated that internal port operations contribute to marine water quality issues. Many examples were sighted such as: shot blasting, the dry dock area, cargo spillages from the off-loading and loading facilities (particularly in the dry bulk precincts) housekeeping along the Wharfs, yacht club vessels, regular oil pollution from operations, ship slops and ballast water discharges. Furthermore, the respondents stated the importance of the Transnet value chain to engage the commodity owners in so far as managing the cargo spills and poor housekeeping along the wharf side are of equal importance. This is attributed to the Standard Operating Procedures not being followed. As mandated by Section 63 of the National Ports Act (RSA, 2005), ports are to conduct routine inspections to determine compliance to licence conditions.

In the Port of Mossel Bay, fish processing discharges have a moderate impact on water quality and these processes are regulated (CSIR, 2017d). It is indicated that the ports must reduce the pollutants which are caused by operational activities. To achieve this the ports are to comply with the existing regulations, national and international standards. Additionally, to effectively strengthen the environmental policies, the ports are to adopt best practices (Anastasopoulos, Kolios and Stylios, 2011).

Onwuegbuchunam et al., (2017) indicate that the discharge of ballast water could contain pathogens and moreover be a travel medium for invasive species which may reproduce rapidly under the new environmental conditions. Furthermore, the IMO is tasked with setting the operating standards to prevent ship source pollution.

Heavy metal concentrations were identified and associated with the dry-dock operations and ship repair facilities. It is important to note that ship repair activities are conducted both internally and externally to the port perimeter. CSIR (2017) indicate that there are many sources of metals into ports, including storm water from the surrounding port areas.

Ten out of fourteen respondents stated that hull cleaning and ship repair activities are one of the major contributors to marine water quality. Hull cleaning of ships in the ports is bound to happen and this is regulated by the MARPOL Annex VI. Prevention of air pollution from ships requires ships to clean hull and propeller in order to reduce the drag and ultimately, results in less fuel consumption. South African seaports have embarked on a hull cleaning licencing process (TNPA, 2018b). CSIR (2018) state that in-water hull cleaning present a potential source of tributyltin in ports. The impact of in-water hull cleaning requires cautious monitoring.

It is important to note that, the United Nations remains committed to marine pollution prevention (UN, 2019). In South Africa, SAMSA is mandated to implement the standards set out by IMO. Although, it has been indicated that there is a dual mandate between SAMSA and DEA, SAMSA remains solely responsible for on board the vessel jurisdiction.

5.4 Marine water quality data impact on pollution prevention strategies

Interviewees were asked how the marine water quality monitoring data has impacted on pollution prevention strategies for the ports. The sentiments shared about this theme are that, knowledge from the monitoring data is there, however, the ports have not moved fast enough to implement prevention strategies. For example, in the Port of Richards Bay, cargo handling operations and old infrastructure are the biggest contributors to poor water quality. Another example is that of Iron Ore concentration levels in Saldanha and their potential impact on aquaculture farms. Again, the data are there but TNPA are not acting rapidly enough to manage the situation. It is clear that, TNPA has a gap to bridge in terms of effectively utilising the monitoring data from the reports produced by the service providers for decision making purposes.

Notably, the legislative requirements are key in bringing order to any operation. However, there are still prevailing issues of unknown sources of pollution. TNPA is no exception to the rule. TNPA has a duty to protect the marine environment as per the National Ports Act (RSA, 2005). Maes (2008, p. 805) indicates that “all states have the obligation to protect the marine environment, while exercising their sovereign right to exploit their natural resources pursuant to their own environmental policies, they have a duty to protect and preserve the marine

environment". Notably, compliance monitoring and enforcement with respect to marine water quality management remains a shared responsibility.

5.5 Effectiveness of implemented pollution prevention strategies

Respondents indicated that various pollution prevention strategies are in place, however, it is their effectiveness that is questionable. Engineering, physical barriers and administrative were some of the controls highlighted. In terms of administrative controls, the ports have a vast number of legislative frameworks that the port users, terminal operators and international vessels are to comply with. However, the enforcement seems to be a challenge. In terms of engineering controls, the respondents indicated that now the opportunity exists, where the project teams are appointed upfront to develop inclusive project specifications and this allows for environmental concept, design and operation to be factored in at an early stage. Finally, respondents indicated that physical barriers do work to some extent, but they are dependent on continuous monitoring and maintenance.

The Port of Durban recently explored the use of permanent containment booms through the Source to Sea project (DEA, 2018) to minimise solid waste entering the port waters. Currently, the ports are looking at sustainable ways of managing the port operations to mitigate environmental degradation. The recently Gazetted Estuarine Management Plan for the Port of East London (DEA, 2018a) as well as the existing Port of Durban Estuarine Management Plan (DEA, 2016a) are some of the tools that the National Ports Authority is implementing to prevent and minimize pollution from both internal and external sources.

5.6 Marine water quality management additional recommendations

The respondents indicated that, the ports should not work in isolation to manage the sources of pollution. The majority of the ports are located in transformed environments. As a result, there is a need to partner with local municipalities, industries, and the public to manage the environment responsibly. Aspects such as awareness, oversight, partnership and capacity building are key to continuous improvement.

There is a need to increase awareness and publicise the monitoring data results, especially where the anthropogenic factors are prevalent. Awareness should start within TNPA, so that TNPA speaks with a unanimous voice. There is a strong belief that partnerships with the municipalities and research institutions can assist the ports in dealing with the factors influencing marine water quality. In terms of enforcement and oversight, the ports have a role

to play with respect to the implementation of the National Ports Act. TNPA issues licences for waste management, bunker operations and terminal operator licences. As a result, the ports are expected to exercise an oversight role through audits and routine inspections. The respondents indicated that, the Long-Term Ecological Monitoring is in place, now is the time to consider developing a marine water quality improvement plans for all eight South Africa's commercial ports.

In relation to capacity building, respondents indicated that to manage the dynamics of the marine environments capacity building is a critical success factor. SAMSA interviewees indicated that as an Authority, naval architects are some of the professionals required to monitor the prevention of pollution from ships and they are currently busy with an international company to source such services. With that said, capacity building, in terms of human resources is one of the aspects that requires urgent attention. Notably, DoT (2017, p. 32) share the same sentiments as it states that "the current state of maritime and related sectors skills is a concern. The shortage of naval architect knowledge and skills requires urgent attention".

5.7 Conclusion

The purpose of this chapter was to set out the findings of the literature and the primary research in the form of a discussion. This allowed for the deliberation of the findings from all perspectives analysed, coded and discussing emerging themes identified. From the data analyses, it is clear that considerable work remains to be done in relation to discharges from the upper catchments into the ports. Notably, TNPA oversight assurance processes and systems at a national level are to ensure that compliance is embedded by any tenant, terminal, port user, or stakeholder where risk involving people, assets and the environment may impact negatively on Transnet, and to manage this in a manner that fulfils the mission and strategic goals of the organization. The conclusions and recommendations made as a result of this discussion are provided in chapter six.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The purpose of this chapter is to link the objectives of the study to the main findings and conclude the study. This chapter also aims to provide recommendations and possible areas for future research.

The research discussed in chapter two the literature review which seeks to explore the marine water quality and coastal management framework, marine water quality management practices in the ports system, monitoring protocol and the management interventions. Chapter three discussed the research methodology used in this study, and explained the reasons for the choice of the methodology. Chapter four presented data analyses. Chapter five discussion. Chapter six discusses the conclusions and recommendations. Furthermore, this chapter is structured as follows. Section 6.2 gives an insight on summary of the objective findings. Section 6.3 discusses conclusions from the study. Section 6.4 provides recommendations. Section 6.5 presents areas for future study.

6.2 Summary of the objective findings

The data collected was evaluated and findings discussed in order to provide an understanding into examining marine water quality management in South African seaports. The study contributed to the objectives and the following findings.

6.2.1 To examine the current marine water quality management practices in South African seaports

The purpose of this study was to examine the current marine water quality management practices in South African seaports. The study revealed that multiple mandates exist regarding the institutional roles and responsibilities. From the TNPA perspective, the National Ports Act (RSA, 2005) requires the ports to regulate and control pollution and the protection of the environment within the port limits as one of the functions. As a result, the long term ecological monitoring programme is in place to provide the ports with data trends over a period of time.

SAMSA's mandate is to prevent and combat pollution of the marine environment as a result of ships, whereas, DEA is tasked with combating the effects of pollution by ships once it has happened. Recent development with respect to the Operation Phakisa project have seen the

facilitation of oceans economy potential. As a result, TNPA plans to expand existing and establish new vessel, oil rig repair, construction operations and to allow in-water hull cleaning of vessel hull in South African seaports. Notably, DAFF has a role to play in relation to the development and sustainable use of marine and coastal resources, however, partnerships need to be nurtured to achieve sustainable marine resources.

Furthermore, the ports, commanded by Section 11 of the National Ports Act (RSA, 2005) embarked on long term ecological monitoring which is designed to look at the key variables, such as dissolved oxygen, pH, Metal concentration and many more. Moreover, the monitoring of the water and sediment quality is to ensure that good water quality is maintained with a healthy ecosystem within the ports. The current monitoring programme is designed to accommodate bi-annual monitoring (summer and winter seasons). TNPA contracted CSIR to facilitate the long term ecological monitoring programme on behalf of all the ports in South Africa, with the exception of the Port of Saldanha. At the present moment, the ports do not have in-house capacity to conduct this monitoring. Each port has strategic sampling sites in the port waters. Each sampling event produces a written report that provides the results, trends and recommendations for management interventions.

6.2.2 To examine the contributing factors to marine water quality in South African seaports

The study intended to examine the contributing factors to marine water quality in South African seaports. The study revealed that most water quality impairment in the ports are due to anthropogenic contaminants ranging from river canals, storm water drains, sewage spills to poor waste management to internal sources such as ship repair and cargo handling operations. All eight ports have similar challenges with regards to the contributing factors on marine water quality. For example, in the Port of Saldanha, the poorly rated sites are located close to the Bok River Mouth, the microbiological contamination are as a result of the waste water discharges into the bay. In the Port of Cape Town, the Alfred Basin is the most significantly impaired water quality where metal concentrations are usually higher than in other parts of the port and in the Duncan Dock where nutrient concentrations are usually high. In the Port of Mossel Bay, the fair to poor water quality classification is mainly as a result of a combination of external and internal events. In the Port of Port Elizabeth, the fair water quality is mainly associated with anthropogenic contaminants from the Baakens River. The excellent and good water quality status in the Port of Ngqura is attributed to minimal anthropogenic activities in and

around the port. In the Port of East London, the poor water quality status is due to the Buffalo River upper catchment activities. The Port of Durban is in the same predicament, as water quality impairment in the upper reach of the Bay are due to the introduction of contaminants by the Amanzimnyama, Umhlathuzana and Umbilo Rivers and these appear to be highest contributors of anthropogenic contaminants to the Bay. Other anthropogenic sources of contaminants include surface run off from neighbouring industrialised and urbanised areas, vessel maintenance and construction facilities, and the spillages of cargo during loading and offloading of vessels. The fair water quality classification for Bhizolo and Mzingazi canals in the Port of Richards Bay is as a result of anthropogenic contaminants from the surrounding urban and industrial areas.

6.2.3 To examine the current and proposed marine water pollution prevention strategies in South African seaports

The third objective was to examine the current and proposed marine water pollution prevention strategies in South African seaports. The study discovered that engineering, physical barriers and administrative were some of the current controls highlighted. Interestingly, the management of South Africa's marine environment is entrusted to the coastal management framework, notwithstanding, the foreign policies to which the country subscribes. Critical to marine water quality management is the Integrated Coastal Management Act (ICM Act) that came into force in 2009. With respect to proposed marine water pollution prevention strategies, interviewees suggested that, the ports are to create awareness and form partnerships with the relevant organisations to manage upper catchments for point source pollution. Second, financial support for non-revenue generating departments to fully discharge their mandate, in this case, the environment management department. Often, strategies require research to assess effectiveness and adaptability, without financial support, it becomes difficult to achieve the pollution management hierarchy. Third, the ports are to start using the long term ecological monitoring data for decision making. Fourth, domesticating regulations for monitoring and enforcement, as this will serve as a tool to embed compliance by relevant stakeholders.

6.3 Conclusions from the study

The broad aim of the study was to examine current marine water quality management practices in South African seaports. A second objective was to examine the contributing factors to marine water quality in South African seaports. Lastly, to examine current and proposed marine water pollution prevention strategies in South African seaports.

Purposive sampling was used to ensure that only those with practical knowledge of the study area and experience in marine water quality management, were selected in this study to share views through semi-structured and face-to face interviews. Of the fourteen interviewees, ten were from Transnet National Ports Authority, two from Council for Science and Industrial Research (CSIR), and two from South African Maritime Safety Authority (SAMSA). The data was manually analysed using open coding and constant comparison to generate themes which reflected on marine water quality management in South African seaports.

The main findings indicate that Transnet National Ports Authority has for the past three years embarked on a national bi-annual ecological monitoring programme for the seven ports with the exception of the Port of Saldanha. Nevertheless, the monitoring protocol is the same. This has allowed for a coordinated monitoring approach. However, the intervention measures are yet to yield results, as most pollution prevention controls are mainly administrative. Ship repair and cargo handling operations rank the highest in terms of the internal contributing factors and discharges from catchment areas such as river canals and storm water run-off from residential and industrial areas rank the highest in relation to external contributing factors to marine water quality. The Council for Science and Industrial Research advises that, in order to make a meaningful contribution, a few years of data is not enough to guide the ports towards management interventions that are financially viable. With respect to the South African Maritime Safety Authority, to fully discharge and enforce 'prevent and combat pollution' mandate, support elements such as compliance and enforcement systems (i.e. ballast water regulations) are required. Awareness and responsible waste management are also some of the administrative and best practices that can be adopted and implemented for continuous improvement. Notably, partnerships between ports and the local municipalities are emerging as the strongest link to managing pollution sources on marine environments. Therefore, the study recommends that the ports conduct impact assessments of ship repair operations on the marine environment. It is also recommended that an integrated maritime industry forum be established to discuss and make holistic decisions that would improve marine water quality management in South Africa’s ports.

6.4 Recommendations

Drawing from the findings in this study, the following are the recommendations.

6.4.1 Management of the ship repair facilities

The long term ecological monitoring reports indicate to ship repair activities as one of the main contributors to heavy metals that ultimately result in poor water and sediment quality in the ports. It is recommended that port management intervention on ship repair processes be given a priority.

6.4.2 Ballast Water Regulations

In order for the authorities to monitor and enforce a yardstick is required, and in this case, the Ballast Water Regulations. SAMSA explained that it is not easy to enforce ballast water management as it is not yet fully regulated. It is therefore recommended that the Department of Transport fast track the adoption of the Ballast Water Bill.

6.4.3 Estuarine Management Plans

The Estuarine Management Plans (EMPs) were developed for the Port of Durban and the Port of East London to mitigate the ecological degradation of the marine environment. It is therefore recommended that the DEA facilitates the delivery and monitor the key management objectives and action plans stipulated in the EMP. It is also recommended that DEA prioritise the completion of the Port of Richards Bay EMP.

6.4.4 Catchment Management Forums

The Department of Water Services is the custodian of the Catchment Management Forums, this platform will make good partnerships with relevant stakeholders to start working with communities, schools and NGOs to create awareness about responsible waste management. It is recommended that researchers in the public and private sectors, inclusive but not limited to the Department of Environmental Affairs, Department of Transport, Department of Agriculture, Forestry and Fisheries, CSIR, and SANBI should work in partnership and dedicate more efforts and resources towards regional monitoring and reporting on marine water quality for the management of the South African coastline.

6.4.5 Partnerships

Interviewed institutions indicated that we need to be organised as the maritime industry. There is a need for a forum between TNPA, DoT, SAMSA and DEA to come up with the strategies for implementation, monitoring and reporting of the IMO adopted treaties. It is therefore,

recommended that an integrated maritime industry forum be established to discuss and make holistic decisions that would improve water quality management in South Africa's ports.

6.4.6 Ecological Monitoring Improvement Plans

The Long-Term Ecological Monitoring Programme is in place, and annual reports are produced for all the ports. Now is the time to consider the management of the repetitive findings. It is therefore recommended that the ports should consider developing marine water quality improvement plans for all eight of South Africa’s commercial ports based on the trend analysis.

6.5 Areas for future study

There is a need to conduct impact assessments of the ship repair operations on the marine environment. It is also recommended that a study examine the relationship between serviced vessels at the ship repair facilities and heavy metal concentration levels in the marine environment. Furthermore, studies should aim to quantify the impact of external factors on port marine environments in order to assist in developing sustainable ports frameworks, and to conduct further studies on environmentally viable technologies for the ship repair facilities. Lastly, this study only interviewed 14 personnel from TNPA, SAMSA and CSIR. Further studies could interview other port stakeholders such as, shipping lines, ship agents, recreational organisations, fishing industry and environmental lobby groups. In addition, institutions such as, DEA, DAFF, DoT, SANBI and many more could also be interviewed to gauge their perspectives on marine water quality management.

References

Ameersingh, S. (2016). *The South African coastal zone: a critical assessment of whether the manner in which the coastal zone is defined in the national environmental management: integrated coastal management Act of 2008 facilitates an integrated, and especially ecosystem based, approach to managing the South African coast*. Masters. University of KwaZulu-Natal, Durban.

Anastasopoulos, D., Kolios, S., & Stylios, C. (2011). How will Greek ports become green ports. *Geo-Eco-Marina, 17*, 73-80.

Auriacombe, C., & Mouton, J. (2007). Qualitative field research. *Journal of Public Administration, 42*(6), 441-457.

Balmford, A., Bennun, L., ten Brink, B., Cooper, D., Côté, I. M., Crane, P., Dobson, A., Dudley, N., Dutton, I., Green, R. E., Gregory, R.D., Harrison, J., Kennedy, E.T., Kremen, C., Leader-Williams, N., Lovejoy, T.E., Mace, G., May, R., Mayaux, P., Morling, P., Phillips, J., Redford, K., Ricketts, T.H., Rodriuez, J.P., Sanjayan, M., Schei, P.J., van Jaarsveld, A.S., & Walther, B. (2005). The Convention on Biological Diversity's 2010 target. *Himalayan Journal of Science, 3*(5), 43-45.

Berjak P, C. G., Huckett B, Pammenter N. (2011). In the Mangroves of South Africa.: School of Biological and Conservation Sciences, University of KwaZulu-Natal.

Borja, A., Bricker, S. B., Dauer, D. M., Demetriades, N. T., Ferreira, J. G., Forbes, A. T., Marques, J. C. (2008). Overview of integrative tools and methods in assessing ecological integrity in estuarine and coastal systems worldwide. *Marine pollution bulletin, 56*(9), 1519-1537.

Bradbury-Jones, C., Taylor, J., & Herber, O. (2014). How theory is used and articulated in qualitative research: Development of a new typology. *Social Science & Medicine, 120*, 135-141.

Brandt, R., Dawes, A., Africa, A., & Swartz, L. (2004). A thematic content analysis of psychologists' reports in child custody evaluations. *South African Journal of Psychology, 34*(2), 259-282.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

Bricki, G., & Green, J. (2007). A Guide to Using Qualitative Research Methodology. *Medecins SANS Frontieres*. http://hdl.handle.net/10144/84230.

Brown, A. C. (1987). Marine pollution and health in South Africa. *South African Medical Journal, 71*(4), 244-248.

Burnard, P., Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Analysing and presenting qualitative data. *British Dental Journal, 204*(8), 429.

Busalacchi, A. (2010). Celebrating a decade of progress and preparing for the future: ocean information for research and application. Proceedings of OceanObs, 9, 10.

Chandra, A., & Idrisova, A. (2011). Convention on Biological Diversity: a review of national challenges and opportunities for implementation. *Biodiversity and Conservation, 20*(14), 3295-3316.

Chevallier, R. (2017). Integrated Marine and Coastal Management in the Western Indian Ocean: Towards A Sustainable Ocean Economy. *South African Institute of International Affairs*. Occassional Paper, 258.

Clark, B.M., Laird, M., Hutchings, K., Liebau, V., Biccard, A., Turpie. J., & Parker-Mallick, N. (2014). The state of Saldanha Bay and Langebaan Lagoon 2013/2014. Technical Report. Report no. 1581/1.

Clark, B.M., Massie, V., Laird, M., Biccard, A., Hutchings, K., Harmer, R., Brown, E., Duna, O.O., Makunga, M., & Turpie, J. (2015). The State of Saldanha Bay and Langebaan Lagoon 2015, Technical Report. Report no. 1642/1.

Clark, B.M., Massie,V., Hutchings, K., Laird, M., Biccard, A., Brown, E., Duna, O.O., & Turpie, J. (2016). The State of Saldanha Bay and Langebaan Lagoon 2016, Technical Report. Report No. AEC 1691/1.

Clark, B.M., Massie,V., Hutchings, K., Brown, E., Biccard, A., Laird, M., Harmer, R., Makhosonke, A., Wright, A., & Turpie, J. (2017). The State of Saldanha Bay and Langebaan Lagoon 2017, Technical Report. Report No. AEC 1741/1.

Costanza, R., Andrade, F., Antunes, P., Van Den Belt, M., Boersma, D., Boesch, D. F., Low, B. (1998). Principles for sustainable governance of the oceans. *Science, 281*(5374), 198-199.

Council for Science and Industrial Research (CSIR). (2013a). Long-Term Ecological Monitoring for the Port of Cape Town: Surveys made in 2013. CSIR Report CSIR/NRE/ECOS/IR/2014/0042/B.

Council for Science and Industrial Research (CSIR). (2013b). Long-Term Ecological Monitoring for the Port of Durban: Surveys made in 2013. CSIR Report CSIR/NRE/ECOS/IR/2014/0011/B.

Council for Science and Industrial Research (CSIR). (2013c). Long-Term Ecological Monitoring for the Port of Mossel Bay: Surveys made in 2013. CSIR Report CSIR/NRE/ECOS/IR/2014/0010/B.

Council for Science and Industrial Research (CSIR). (2013d). Long-Term Ecological Monitoring for the Port of Ngqura: Surveys made in 2013. CSIR Report CSIR/NRE/ECOS/IR/2014/0009/B.

Council for Science and Industrial Research (CSIR). (2013e). Long-Term Ecological Monitoring for the Port of Port Elizabeth: Surveys made in 2013. CSIR Report CSIR/NRE/ECOS/IR/ 2014/0023/B.

Council for Science and Industrial Research (CSIR). (2013f). Long-Term Ecological Monitoring of Richards Bay: Surveys made in 2013. CSIR Report CSIR/NRE/ECOS/IR/2014/0043/B.

Council for Science and Industrial Research (CSIR). (2013g). Long-Term Ecological Monitoring Programme for the Port of East London: Surveys made in 2013. CSIR Report CSIR/NRE/ ECOS/IR/2014/0008/B.

Council for Science and Industrial Research (CSIR). (2016a). Long-Term Ecological Monitoring Programme for the Port of Cape Town: Surveys made in 2015/2016. CSIR Report CSIR/NRE/ECOS/IR /2016/0148/C.

Council for Science and Industrial Research (CSIR). (2016b). Long-Term Ecological Monitoring Programme for the Port of Durban: Surveys made in 2015/2016. CSIR Report CSIR/NRE/ECOS/IR /2016/0147/C.

Council for Science and Industrial Research (CSIR). (2016c). Long-Term Ecological Monitoring Programme for the Port of East London: Surveys made in 2015/2016. CSIR Report CSIR/NRE/ECOS/IR /2016/0149/C.

Council for Science and Industrial Research (CSIR). (2016d). Long-Term Ecological Monitoring Programme for the Port of Mossel Bay: Surveys made in 2015/2016. CSIR Report CSIR/NRE/ECOS/IR /2016/0150/C.

Council for Science and Industrial Research (CSIR). (2016e). Long-Term Ecological Monitoring Programme for the Port of Ngqura: Surveys made in 2015/2016. CSIR Report CSIR/NRE/ECOS/IR /2016/0151/C.

Council for Science and Industrial Research (CSIR). (2016f). Long-Term Ecological Monitoring Programme for the Port of Port Elizabeth: Surveys made in 2015/2016. CSIR Report CSIR/NRE/ECOS/IR /2016/0152/C.

Council for Science and Industrial Research (CSIR). (2016g). Long-Term Ecological Monitoring Programme for the Port of Richards Bay: Surveys made in 2015/2016. CSIR Report CSIR/NRE/ECOS/IR /2016/0153/C.

Council for Science and Industrial Research (CSIR). (2017a). Long-Term Ecological Monitoring Programme for the Port of Cape Town: Surveys made in 2016/2017. CSIR Report CSIR/NRE/ECOS/IR/2017/0082/C.

Council for Science and Industrial Research (CSIR). (2017b). Long-Term Ecological Monitoring Programme for the Port of Durban: Surveys made in 2016/2017. CSIR Report CSIR/NRE/ECOS/IR/2017/0083/C.

Council for Science and Industrial Research (CSIR). (2017c). Long-Term Ecological Monitoring Programme for the Port of East London: Surveys made in 2016/2017. CSIR Report CSIR/NRE/ECOS/IR/2017/0084/C.

Council for Science and Industrial Research (CSIR). (2017d). Long-Term Ecological Monitoring Programme for the Port of Mossel Bay: Surveys made in 2016/2017. CSIR Report CSIR/NRE/ECOS/IR/2017/0085/C.

Council for Science and Industrial Research (CSIR). (2017e). Long-Term Ecological Monitoring Programme for the Port of Ngqura: Surveys made in 2016/2017. CSIR Report CSIR/NRE/ECOS/IR/2017/0086/C.

Council for Science and Industrial Research (CSIR). (2017f). Long-Term Ecological Monitoring Programme for the Port of Port Elizabeth: Surveys made in 2016/2017. CSIR Report CSIR/NRE/ECOS/IR/2017/0087/C.

Council for Science and Industrial Research (CSIR). (2017g). Long-Term Ecological Monitoring Programme for the Port of Richards Bay: Surveys made in 2016/2017. CSIR Report CSIR/NRE/ECOS/IR/2017/0088/C.

Creswell, J. W. (2014). A concise introduction to mixed methods research: Sage Publications.

Crowder, L.B., Osherenko, G., Young, O.R., Airame, S., Norse, E.A, Baron, N., Day, J.C., Douvere, F., Ehler, C.N., Halpern, B.S., Langdon, S.J., McLeod, K.L., Ogden, J.C., Peach, R.E., Rosenberg, A.A., & Wilson, J.A. (2006). Resolving Mismatches in U.S. Ocean Governance. *Science, 313* (5787), 617 - 618.

Dafforn, K. A., Lewis, J. A., & Johnston, E. L. (2011). Antifouling strategies: history and regulation, ecological impacts and mitigation. *Marine Pollution Bulletin, 62*(3), 453-465.

Darbra, R., Ronza, A., Stojanovic, T. A., Wooldridge, C., & Casal, J. (2005). A procedure for identifying significant environmental aspects in sea ports. *Marine Pollution Bulletin, 50*(8), 866-874.

Department of Agriculture, Forestry and Fisheries (DAFF). (2013). Legal Guide for the Aquaculture Sector in South Africa. Pretoria, DAFF.

Department of Environmental Affairs. (2012a). 2nd South Africa Environment Outlook. A report on the state of the environment. Executive Summary. Department of Environmental Affairs, Pretoria. 60 pp.

Department of Environmental Affairs. (2012b). South African Water Quality Guidelines for Coastal Marine Waters. Volume 2: Guidelines for Recreational Use. Department of Environmental Affairs, Cape Town.

Department of Environmental Affairs. (2014a). The National Coastal Management Programme of South Africa. Cape Town.

Department of Environmental Affairs. (2014b). National Guideline for the Discharge of Effluent from Land-based Sources into the Coastal Environment. Pretoria, South Africa.

Department of Environmental Affairs. (2014c). White Paper on National Environmental Management of the Ocean. Government Notice No. 37692

Department of Environmental Affairs. (2015). DEA Five Year Strategic Plan 2015/16 – 2019/20. Department of Environmental Affairs, Pretoria. South Africa.

Department of Environmental Affairs. (2016a). Durban Bay: Estuarine Management Plan. Department of Environmental Affairs, Cape Town.

Department of Environmental Affairs. (2016b, 6-7 June). *Exploring Opportunities: Towards a National Maritime Cluster*. Paper presented at the Operation Phakisa: Oceans Economy Seminar Port Elizabeth.

Department of Environmental Affairs. (2016c). 2016 World Oceans Day. [Online] Avilable at: https://www.environment.gov.za/event/international/2016world_oceansday (Accessed 11 February 2019).

Department of Environmental Affairs, (2017). Environment Quarterly. *Climate Change Action Now!* Department of Environmental Affairs, Pretoria.

Department of Environmental Affairs, (2018a). Buffalo River Estuarine Management Plan. Department of Environmental Affairs, Cape Town.

Department of Environmental Affairs, (2018b). Environment Quarterly. In October-December (Ed.), *Conserving Migratory Waterbirds*.

Department of Environmental Affairs, (2018c). Permit No. 07/2018 Port of Durban. Cape Town.

Department of Environmental Affairs (2018d). South African Water Quality Guidelines for Coastal Marine Waters - Natural Environment and Mariculture Use. Cape Town.

Department of Environmental Affairs. (2019, February 21) DEA leads South African pilot project on water quality in Port Elizabeth. [Online] Available at: https://www.environment.gov.za/mediarelease/dea_leadssapilotprojectonwaterquality. (Accessed 1 March 2019).

Department of Environmental Affairs and Tourism (DEAT). (2008). South Africa's national programme of action for protection of the marine environment from land-based activities. Department of Environmental Affairs, Cape Town:

Department: Planning, Monitoring and Evaluation (DPME). (2019). Overview. [Online] Available at: https://nationalgovernment.co.za/units/view/29/department-planning-monitoring-and-evaluation (Accessed 20 January 2019).

Department of Public Enterprises (DPE). (2014). About DPE. [Online] Available at: http://www.dpe.gov.za/about/Pages/About-Us.aspx (Accessed 20 January 2019).

Department of Transport (DOT). (2017). Comprehensive Maritime Transport Policy For South Africa. Pretoria.

Department of Water Affairs and Forestry, (1995). South African Water Quality Guidelines for Coastal Marine Waters (Vol. 1).

Department of Water Affairs and Forestry, (1996). South African Water Quality Guidelines *Aquatic Ecosystems* (Vol. 7).

Department of Water Affairs and Forestry, (2008). Water Resource Protection and Assessment Policy Implementation Process. Resource Directed Measures for Protection of water resources: Methodology for the Determination of the Ecological Water Requirements for Estuaries. (Vol. 2). Pretoria.

Department of Water and Sanitation (DWS). (2019). Water and Sanitation. [online] Available at: https://www.gov.za/about-sa/water-affairs (Accessed 20 January 2019).

Derraik, J. G. (2002). The pollution of the marine environment by plastic debris: a review. *Marine Pollution Bulletin, 44*(9), 842-852.

Doherty, G.M. (2010). Celebrating a Decade of Progress and Preparing the Future: The Satellite Perspective. in Proceedings of OceanObs, 9, 10.

Driver, A. S., K J., Nel, J L., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P A., Harris, L., Maze, K. (2012). National Biodiversity Assessment 2011: An assessemnt of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs. Pretoria.

Du Plooy-Cilliers, F., Davis, C., & Bezuidenhout, R. M. (2014). *Research Matters*: Juta

Edwards, A. (2001). *ISO 14001 environmental certification step by step*. 1st ed. Oxford: Wright, pp.79 - 119.

Egnal, N. S. (1973). A dyadic approach to thematic apperception. *South African Medical Journal, 47*(41), 1967-1968.

Ehler, C., & Douvere, F. (2009). Marine Spatial Planning: a step-by-step approach toward ecosystem-based management. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. Paris, France, UNESCO, 99pp. doi:http://dx.doi.org/10.25607/OBP-43.

Encyclopedia.com (2016). "Marine Water Quality." Environmental Science: In Context. [Online] Available at: https://www.encyclopedia.com/environment/energy-government-and-defense-magazines/marine-water-quality. (Accessed 21 February 2019).

Flint, N., Jackson, E., Wilson, S., Verlis, K., & Rolfe, J. (2015). Synthesis of water quality influences in ports of the Fitzroy region, Queensland. *A report to the Fitzroy Basin Association for the Fitzroy Water Quality Improvement Plan.* CQUniversity Australia, North Rockhampton, Queensland.

Foley M.M., Halpern, B.S., Michel, F., Armsby, M.H., Caldwell, M.R., Crain, C.M., Prahler, E., Rohr, N., Sivas, D., Beck, M.W., Carr, M.H., Crowder, L.B., Emmett Duffy, J., Hacker, S.D., McLeod, K.L., Palumbi, S.R., Peterson, C.H., Regan, H.M., Ruckelshaus, M.H., Sandifer, P.A., & Steneck, R.S. (2010). Guiding ecological principles for marine spatial planning. *Marine Policy, 34*(5), 955-966, doi:10.1016/j.marpol.2010.02.001.

Gama, S. (2018). Transnet Integrated Management System Commitment Statement (Vol. 1). Johannesburg. Transnet.

GHD. (2013). Environmental Best Practice Port Development:An Analysis of International Approaches, report prepared for the Department of Sustainability, Environment, Water, Population and Communities. Canberra, Australia.

Glazewski, J. (2013). Ocean governance: A first step. *South African Journal of Science, 109*(3-4), 01-02.

Global Environment Facility. (2019). Conventions. [Online] Available at: https://www.thegef.org/partners/conventions (Accessed 21 January 2019).

Global Environment Facility. (2019). Going with the Flow: Ecosystem-based governance of the Benguela Current Large Marine Ecosystem. [Online] Available at:

https://www.thegef.org/news/going-flow-ecosystem-based-governance-benguela-current-large-marine-ecosystem (Accessed 21 January 2019).

Globe B.J., & Oellermann L.K. (2014). Ugu Lwethu-Our Coast. A profile of coastal Kwazulu Natal. (pp. 202pp): KwaZulu Natal Department of Agriculture and Environmental Affairs and the Oceanograpgic Research Institute.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 597-606.

Goulding, C. (2005). Grounded theory, ethnography and phenomenology: A comparative analysis of three qualitative strategies for marketing research. *European Journal of Marketing, 39*(3/4), 294-308.

Graneheim, U. H., Lindgren, B.M., & Lundman, B. (2017). Methodological challenges in qualitative content analysis: A discussion paper. *Nurse Education Today, 56*, 29-34.

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 24*(2), 105-112.

Gumede, S. and Chasomeris, M. (2018) Pricing Strategy and Tariff Structure for a Port Authority: A Case Study of South Africa. *Maritime Policy and Management*. Online version: pp. 1-14. https://doi.org/10.1080/03088839.2018.1446103.

Havenga, J., Simpson, Z., & Goedhals-Gerber, L. (2016). International trade logistics costs in South Africa: Informing the port reform agenda. *Research in Transportation Business & Management*, *22*, 263-275.

Hens, L., & Stoyanov, S. (2011). Water management in the framework of environmental management systems in Bulgarian seaports. Physics and Chemistry of the Earth, Parts A/B/C, 36(5-6), 141-149.

Heydoorn, A. E. F. (1973). Aquaculture: a substitute for management of living marine resources? *South African Journal of Wildlife Research, 3*(2), 109-114.

Hoepfl, M. C. (1997). Choosing Qualitative Research: A Primer for Technology Education Researchers. *Journal of Technology Education, 9*(1) 47-63.

Hovey, R. K., Statton, J., Fraser, M. W., Ruiz-Montoya, L., Zavala-Perez, A., Rees, M., Kendrick, G. A. (2015). Strategy for assessing impacts in ephemeral tropical seagrasses. *Marine Pollution Bulletin, 101*(2), 594-599.

International Maritime Organisation. (2019a). Convention on the Prvention of Marine Pollution by Dumping of Wastes and Other Matter. [Online] Available at:

http://www.imo.org/en/OurWork/Environment/LCLP/Pages/default.aspx (Accessed 20 January 2019).

International Maritime Organisation. (2019b). International Convention for the Safety of Life at Sea (SOLAS), 1974. [Online] Available at: http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Safety-of-Life-at-Sea-(SOLAS),-1974.aspx (Accessed 21 January 2019).

International Institute for Sustainable Seaports. (2013). Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices. Global Environment and Technology Foundation Report, Port of Portland.

Kolb, S. M. (2012). Grounded theory and the constant comparative method: Valid research strategies for educators. *Journal of Emerging Trends in Educational Research and Policy Studies, 3*(1), 83-86.

KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs. (2017). KwaZulu-Natal Coastal Management Programme, KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs, Pietermaritzburg.

Le Grange, L. (2018). What is (post)qualitative research? *South African Journal of Higher Education, 32*(5), 1-14. doi:http://dx.doi.org/10.20853/32-5-3161

Lee, G. F., & Jones-Lee, A. (2003). *Regulating water quality impacts of port and harbor stormwater runoff.* Paper presented at the International Symposium on Prevention of Pollution from Ships, Shipyards, Drydocks, Ports, and Harbors, New Orleans, LA. Retrieved December.

Lewis, S. (2015). Qualitative inquiry and research design: Choosing among five approaches. *Health Promotion Practice, 16*(4), 473-475.

Lindenmayer, D. B., & Likens, G. E. (2010). The science and application of ecological monitoring. *Biological Conservation, 143*(6), 1317-1328.

MacDonald, C. (2012). Understanding participatory action research: A qualitative research methodology option. *The Canadian Journal of Action Research, 13*(2), 34-50.

Mackie, K. (1982). Establishment of the SAICE Marine Division. *Civil Engineering = Siviele Ingenieurswese, 1982*(v24i4), 88.

Maes, F. (2008). The international legal framework for marine spatial planning. *Marine Policy, 32*(5), 797-810.

Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. AISHE-J: *The All Ireland Journal of Teaching and Learning in Higher Education*, 9(3).

Malterud, K. (2001). Qualitative research: standards, challenges, and guidelines. *The Lancet, 358*(9280), 483-488.

Mandela, N. (1998). Excerpt from a message to an international conference on 'co-operation for the development and protection of the coastal and marine environment in Sub Saharan Africa', Cape Town, December 1998, quoted in the White Paper for Sustainable Coastal Development in South Africa, https://www.westerncape.gov.za/text/2004/12/sectiona.doc (Accessed 16 June 2019).

Mardon, D., & Stretch, D. (2004). Comparative assessment of water quality at Durban beaches according to local and international guidelines. *Water SA, 30*(3), 317-323.

Marshall, M.N. (1996). Sampling for Qualitative Research. *Family Practice, 13*(6), 522-526.

Maxwell, J. A. (2012). Qualitative Research Design: An Interavtive Approach. Sage Publications.

McClanahan, T. R. (1988). Seasonality in East Africa's coastal waters. *Marine Ecology, 44*, 191- 199.

Morris, T., Hermes, J., Beal, L., Du Plessis, M., Rae, C. D., Gulekana, M., Ansorge, I. J. (2017). The importance of monitoring the Greater Agulhas Current and its inter-ocean exchanges using large mooring arrays. *South African Journal of Science, 113*(7-8), 1-7.

Mukherjee, P. K., & Bal, A. B. (2011). The Status of International and Regional Conventions relating to Ship Source Marine Pollution in States in the Baltic Region. Baltic Sea Region Programme 2007 – 2013.

Namibia, South Africa sign fisheries MoU. (2019, January 24). *Creamer media*, pp. 1.

National Development Plan (NDP). (2019) [Online] Available at: https://www.gov.za/issues/national-development-plan-2030 (Accessed 20 February 2019).

O'Reilly, M., & Parker, N. (2013). 'Unsatisfactory Saturation': a critical exploration of the notion of saturated sample sizes in qualitative research. *Qualitative Research, 13*(2), 190-197.

Oelofse, S. H. H., Viljoen, P., Taljaard, S., & Botes, W. A. M. (2004). Discharge of water containing waste emanating from land to the marine environment : a water quality management perspective. *Water SA, 30*(5), 56-60.

Onwuegbuchunam, D., Ebe, T., Okoroji, L., & Essien, A. (2017). An Analysis of Ship-Source Marine Pollution in Nigeria Seaports. *Journal of Marine Science and Engineering, 5*(3), 39.

Permanent International Association of Navigation Congress (PIANC). (2010). The World Association for Waterborne Transport Infrastructure, an association in a changing world, *Civil Engineering, 163* (5)1885-2010.

Poggenpoel, M., Myburgh, C., & Van der Linde, C. (2001). Qualitative research strategies as prerequisite for quantitative strategies. *Education, 122*(2).

Pouliquen, S. (2010). "The Development of the Data System and Growth in Data Sharing" in these proceedings, 1, 30.

Priebe, G., & Strang, S. (2016). Micro Level Impact of the Right to Health – A Qualittative Study of Patient Perceptions. *Diversity and Equality in Health and Care, 13*(5), 319-325.

Rall, S. (2019, May 7). Raw sewage flows into harbour. *The Mercury*, [Online] Available at: https://www.iol.co.za/mercury/news/raw-sewage-flow-into-harbour-22756098 (Accessed 14 June 2019).

Republic of South Africa, Sea Shores Act 21, 1935.

Republic of South Africa, Price Edward Islands Act 43, 1948.

Republic of South Africa, Sea Birds and Seals Protection Act 46, 1973.

Republic of South Africa, Dumping at Sea Control Act 73, 1980.

Republic of South Africa, Marine Pollution Act 2, 1986.

Republic of South Africa, Sea Fishery Act 73, 1988.

Republic of South Africa, Marine Living Resources Act 18, 1989.

Republic of South Africa, Antarctic Treaties Act 60, 1996a.

Republic of South Africa, The Constitution Act 108, 1996b.

Republic of South Africa, National Environment Management Act, 1998a.

Republic of South Africa, National Water Act 36, 1998b.

Republic of South Africa, South Africam Maritime Safety Authority 5, 1998c.

Republic of South Africa, National Heritage Resources Act 25, 1999.

Republic of South Africa, National Environmental Management: Protected Areas Act 57, 2003.

Republic of South Africa, National Environment Management: Biodiversity Act 10, 2004a.

Republic of South Africa, National Environmental Management Act: Air Quality 39, 2004b.

Republic of South Africa, National Ports Act 12, 2005.

Republic of South Africa, National Environment Management: Integrated Coastal Management Act 24, 2008a.

Republic of South Africa, National Environmental Management: Waste Act 59, 2008b.

Republic of South Africa, Port Rules for the Harbours of South Africa, 2009.

Sachs, J. D., & Reid, W. V. (2006). Investments toward sustainable development. *Science, 312*(5776), 1002-1002.

Sachs, J. D. (2012). From millennium development goals to sustainable development goals. *The Lancet, 379*(9832), 2206-2211.

Sainsbury, K. J., Punt, A. E., & Smith, A. D. (2000). Design of operational management strategies for achieving fishery ecosystem objectives. *ICES Journal of Marine Science, 57*(3), 731-741.

Saunders, M., Lewis, P., & Thornhill, A. (2016). Research methods for business students. Harlow: Pearson Education.

Schipper, C., Vergouwen, S., Vreugdenhill, H., de Bel, M., & Schasfoort, F. (2015). Port of the Future, exploratory study. Deltares Report. Report no. 1220137-000-ZKS-0005.

Smith, J., & Firth, J. (2011). Qualitative Data Analysis: Application of the Framework Approach. *Nurse Researcher, 18* (2) 52-62.

South African Maritime Safety Authority (SAMSA). (2015). Five Year Strategic Plan 2015-2020. Pretoria, SAMSA.

South African Heritage Resources Agency (SAHRA). (2019). About SAHRA. [Online] Available at: https://www.sahra.org.za/about-us/ (Accessed 21 March 2019).

South African National Biodiversity Institute (SANBI). (2008). Guidelines for Offshore Marine Protected Areas in South Africa. [Online] Available at: http://www.sanbi.org/information/documents (Accessed 21 January 2019).

South African National Biodiversity Institute (SANBI). (2019). Overview. [Online] Available at: https://nationalgovernment.co.za/units/view/283/south-african-national-biodiversity-institute-sanbi (Accessed 21 January 2019).

South African Waste Information System (SAWIS). (2019). Waste Information System. [Online] Available at: http://sawic.environment.gov.za/ (Accessed 20 January 2019).

South African Weather Services (SAWS). (2019). South African Weather Services. [Online] Available at: https://www.environment.gov.za/statutorybodies/saws (Accessed 20 March 2019).

Spalding, M. J. (2016). The new blue economy: the future of sustainability. *Journal of Ocean and Coastal Economics, 2*(2), 8.

Srivastava, A. & Thomson, S. B. (2009). Framework Analysis: A Qualitative Methodology for Applied Policy Research. *Journal of Administration and Governance*, 4(2), 72-79.

Storey, V. C., Trujillo, J. C., & Liddle, S. W. (2015). Research on conceptual modeling: Themes, topics, and introduction to the special issue. *Data and Knowledge Engineering*, *98*, 1-7.

Sustainable Seas Trust. (2018). African Marine Waste Network. *What Is The Project.* [online] Available at: http://www.sst.org.za/african-marine-network (Accessed 14 November 2018).

Taljaard, S., Monteiro, P. M. S., & Botes, W. A. M. (2006). A structured ecosystem-scale approach to marine water quality management. *Water SA*, *32*(4), 535-542.

Taljaard, S., & van Niekerk, L. (2012). How supportive are existing national legal regimes for multi-use marine spatial planning?- The South African case. *Marine Policy* (38) 72-79.

Transnet National Port Authority, (2010). A Basic Guide to Environmental Management in the South African Ports. Johannesburg. TNPA.

Transnet National Ports Authority. (2013). Operations philosophy, Johannesburg, TNPA.

Transnet National Port Authority, (2015). Master Agreement between Transnet and CSIR for the provision of Water Quality Monitoring Service. Johannesburg. TNPA.

Transnet National Ports Authority, (2017). Business Review. Johannesburg.

Transnet National Port Authority, (2017). Port Statistics, [Online] Available at: https://www.transnetnationalportsauthority.net/Commercial%20and%20Marketing/Pages/Port-Statistics.aspx (Accessed 17 June 2019).

Transnet National Port Authority, (2018). Port Statistics, [Online] Available at: https://www.transnetnationalportsauthority.net/Commercial%20and%20Marketing/Pages/Port-Statistics.aspx (Accessed 17 June 2019).

Transnet National Port Authority, (2018b). TNPA Hull Cleaning Permit. Johannesburg, TNPA.

Transnet National Ports Authority, (2019). Port Statistics, [Online] Available at: https://www.transnetnationalportsauthority.net/Commercial%20and%20Marketing/Pages/Port-Statistics.aspx (Accessed 17 June 2019).

Tong, A., Flemming, K., McInnes, E., Oliver, S., & Craig, J. (2012). Enhancing transparency in reporting the synthesis of qualitative research: ENTREQ. *BMC Medical Research Methodology*, *12*(1), 181.

UNCLOS. (1994). United Nations Convention on the Law of the Sea. United Nations [Online] Available at

:http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf (Accessed 17 January 2019).

UN Environment. (2017). Realizing Integrated Regional Oceans Governance – Summary of case studies on regional cross-sectoral institutional cooperation and policy coherence.

United Nations Environment Programme (2018). Nairobi Convention. [Online] Available at: https://www.unenvironment.org/nairobiconvention/ (Accessed 17 November 2018).

UNESCO. (2017). Intergovernmental Oceanographic Commission. [Online] Available at: http://www.unesco.org/new/en/natural-sciences/ioc-oceans/about-us/. (Accessed 02 February 2019)

Vrancken, P. H. G. (2011). Introductory perspectives on marine tourism in South African law. *Obiter, 32*(3), 613-633.

Walker, T. (2018). Securing a sustainable oceans economy: South Africa's approach. *ISS Southern Africa Report, 2018*(14), 1-24.

Water Research Commission (2015). Water and regional Integration. *The role of water as a driver of regional economic integration in Southern Africa*. WRC Report No 2252/1/14

Weaver, K., & Olson, J. K. (2006). Understanding paradigms used for nursing research. *Journal of Advanced Nursing, 53*(4), 459-469.

Whittemore, R., Chase, S. K., & Mandle, C. L. (2001). Validity in qualitative research. *Qualitative Health Research, 11*(4), 522-537.

WWF-SA. (2016). Oceans facts and futures: Valuing South Africa's ocean economy. Cape Town: WWF-SA.

Appendix 1: Summary of relevant legislation on marine water quality

Legislation	Intent	Competent Authority
South African Constitution, Act 108 of 1996	To introduce a new Constitution for the Republic of South Africa and to provide for matters incidental to the management of the environment	Department of Environmental Affairs Department of Public Enterprise Department of Transport Department of Water Affairs South African Maritime Safety Authority
South African Maritime Safety Authority, Act 5 of 1998	To regulate and enforce maritime safety, marine pollution from ships and to promote South Africa's maritime interests	South African Maritime Safety Authority
National Environmental Management Act, Act 107 of 1998	To establish principles for decision-making on matters affecting the environment	Department of Environmental Affairs
National Environmental Management: Protected Areas Act, Act 57 of 2003	This Act creates a national system of protected areas in order to protect and conserve environmentally viable areas representative of biodiversity in the country. It further pursues to achieve complaisant environmental governance and to stimulate sustainable and equitable utilization and community participation	Department of Environmental Affairs
National Environmental Management: Air Quality Act, Act 39 of 2004	To reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation	Department of Environmental Affairs
National Environmental Management: Biodiversity Act, Act 10 of 2004	To provide for the management and conservation of the South Africa's biodiversity within the context of the National Environmental Management Act, Act 107 of 1998.	Department of Environmental Affairs South African National Biodiversity Institute

	Furthermore, the Act introduces several legislated planning tools to assist with the management and conservation of South Africa's biological diversity	
National Environmental Management: Integrated Coastal Management Act, Act 24 of 2008	To establish a system of integrated coastal and estuarine management in the Republic; warrants that development and the use of natural resources within the coastal zone is socially, economically justifiable and ecologically sustainable; determines the accountabilities of the organs of state in relation to coastal areas; controls dumping at sea and pollution in the coastal zone; and gives effect to South Africa's international obligations in relation to coastal matters	Department of Environmental Affairs
National Environmental Management: Waste Act, Act 59 of 2008	To reform the law regulating waste management in order to protect health and the environment	Department of Environmental Affairs South African Waste Information Centre
National Heritage Resources Act, Act 25 of 1999	To introduce an integrated and interactive national heritage resources	South African Heritage Resources Agency
National Ports Act, Act 12 of 2005	To own, manage, control and administer ports to ensure their efficient and economic functioning, and control land use within ports, provide access to and arrange services for ports, maintain the sustainability of ports and manage the pollution and protection of the port environment	Department of Public Enterprise Department of Transport
Marine Pollution Act, Act 2 of 1986	To protect the State's marine and coastal environment from pollution by oil and certain other	Department of Transport South African Maritime Safety Authority

	marine pollutants	
Marine Living Resources Act, Act 18 of 1989	Aims to provide for the conservation of the marine ecosystem, the long term sustainable utilization of marine living resources, the orderly access to exploitation, utilization and protection of marine living resources and to provide for the exercise of control over marine living resources in a fair and equitable manner of all citizens of South Africa	Department of Agriculture, Forestry and Fisheries
Port Rules for the Harbours of South Africa	To establish, develop and maintain South African Ports and the protection of the environment	Department of Public Enterprise Department of Transport
Sea Shores Act, Act 21 of 1935	Proclaims the President to be the proprietor of the sea-shore and the sea within South Africa's territorial water and regulate the granting of rights and alienation thereof	The Presidency
Sea Birds and Seals Protection Act, Act 46 of 1973	Provides for control over certain islands and rocks for the safeguard and upkeep of seabirds and seals	Department of Environmental Affairs
Dumping at Sea Control Act, Act 73 of 1980	Regulates the control of discarding substances at sea	Department of Environmental Affairs
Sea Fishery Act, Act 73 of 1988	Concerned with regulating activities in Antarctica comprising territorial claims, research and stringent environmental protection in general and the protection of certain recognised species such as seals	Department of Agriculture, Forestry and Fisheries
Antarctic Treaties Act, Act 60 of 1996	This treaty is predominantly concerned with the regulation of activities in the Antarctica, such as territorial claims, research, and many more	Department of Environmental Affairs
Prince Edward Islands Act, Act 43 of 1948	The annexation to the Union of South Africa of the Prince Edward islands, and for the	Department of Environmental Affairs

	administration, government and control of the said islands

Source: Author compiled information from South African legislation as cited in the table.

Appendix 2: South African Water Quality Guidelines for Coastal Marine Waters

Indicator	**Target Value or Concentration**
Temperature	The maximum acceptable variation in ambient temperature is ± 1oC.
Salinity	33 - 36
pH	7.3 - 8.2
Dissolved oxygen	Should not fall below 5 mg.l-1 99% of the time and below 6 mg.l-1 95% of the time.
Turbidity	Should not reduce the depth of the euphotic zone by more than 10% of background levels measured at a comparable control site.
Total suspended solids	Should not be increased by more than 10% of the ambient concentration.
Nutrients	Waters should not contain concentrations of dissolved nutrients that are capable of causing excessive or nuisance growth of algae or other aquatic plants or reducing dissolved oxygen concentrations below the target range indicated for dissolved oxygen.
Arsenic	12 µg.l-1
Cadmium	4 µg.l-1
Copper	5 µg.l-1
Chromium	8 µg.l-1
Mercury	0.3 µg.l-1
Nickel	25 µg.l-1
Lead	12 µg.l-1
Zinc	25 µg.l-

Source: Author compiled information from DWAF, 1995, p.43.

Appendix 3: Informed Consent Letter

Informed Consent Letter 3C

UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP

Dear Respondent,

MBA Research Project
Researcher: Simphiwe I Mazibuko [redacted]
Supervisor: Dr. Mihalis Chasomeris (031-2602575)
Research Office:
HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville Campus, Govan Mbeki Building, Private Bag X 54001 Durban 4000.
KwaZulu-Natal, SOUTH AFRICA Tel: 27 31 2604557- Fax: 27 31 2604609 Email:
HSSREC@ukzn.ac.za

I, **Simphiwe Innocentia Mazibuko** an MBA student, at the Graduate School of Business and Leadership, of the University of KwaZulu Natal. You are invited to participate in a research project entitled: ***Examining Marine Water Quality Management in South African Seaports***. The aim of this study qualitative study will be to:

Examine marine water quality management practices in South African Seaports, and to shed an insight on marine water quality issues, where necessary, examine and define management practices that could be implemented to improve marine water quality in the South African seaport system.

Through your participation I hope to understand marine water quality management across the eight commercial seaport system. The interviews are intended to contribute to my examination of water quality analysis and measures and where possible provide recommendations for improvement.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this interview. Confidentiality and anonymity of records identifying you as a participant will be maintained by primary researcher and the Graduate School of Business and Leadership, UKZN.

If you have any questions or concerns about participating in this study, you may contact me or my supervisor at the numbers listed above.

The interview should take you about fourth five **(45)** minutes to complete. I hope you will take the time to participate.

Sincerely

Simphiwe Innocentia Mazibuko

Investigator's signature_____ Date_____

This page is to be retained by participant

UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP

MBA Research Project
Researcher: Simphiwe I Mazibuko [redacted]
Supervisor: Professor. Mihalis Chasomeris (031-2602575)
Research Office:
HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville Campus, Govan Mbeki Building, Private Bag X 54001 Durban 4000.
KwaZulu-Natal, SOUTH AFRICA Tel: 27 31 2604557- Fax: 27 31 2604609 Email: HSSREC@ukzn.ac.za

CONSENT

I……(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.
I understand that I am at liberty to withdraw from the project at any time, should I so desire.

I hereby provide consent to:

Audio-record my interview YES / NO

SIGNATURE OF PARTICIPANT DATE

……

This page is to be retained by researcher

Appendix 4: Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

11 February 2019

Ms Simphiwe Innocentia Mazibuko (982183744)
Graduate School of Business & Leadership
Westville Campus

Dear Ms Mazibuko,

Protocol reference number: HSS/0106/019M
Project title: Examining Marine Water Quality Management in South African Seaports

Approval Notification – Expedited Application

In response to your application received on 08 February 2019, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]
Dr Shamila Naidoo (Deputy Chair)

/ms

Cc Supervisor: Dr Mihalis Chasomeris
cc Academic Leader Research: Professor Muhammad Hoque
cc School Administrator: Ms Zarina Bullyraj

Humanities & Social Sciences Research Ethics Committee
Dr Rosemary Sibanda (Chair)
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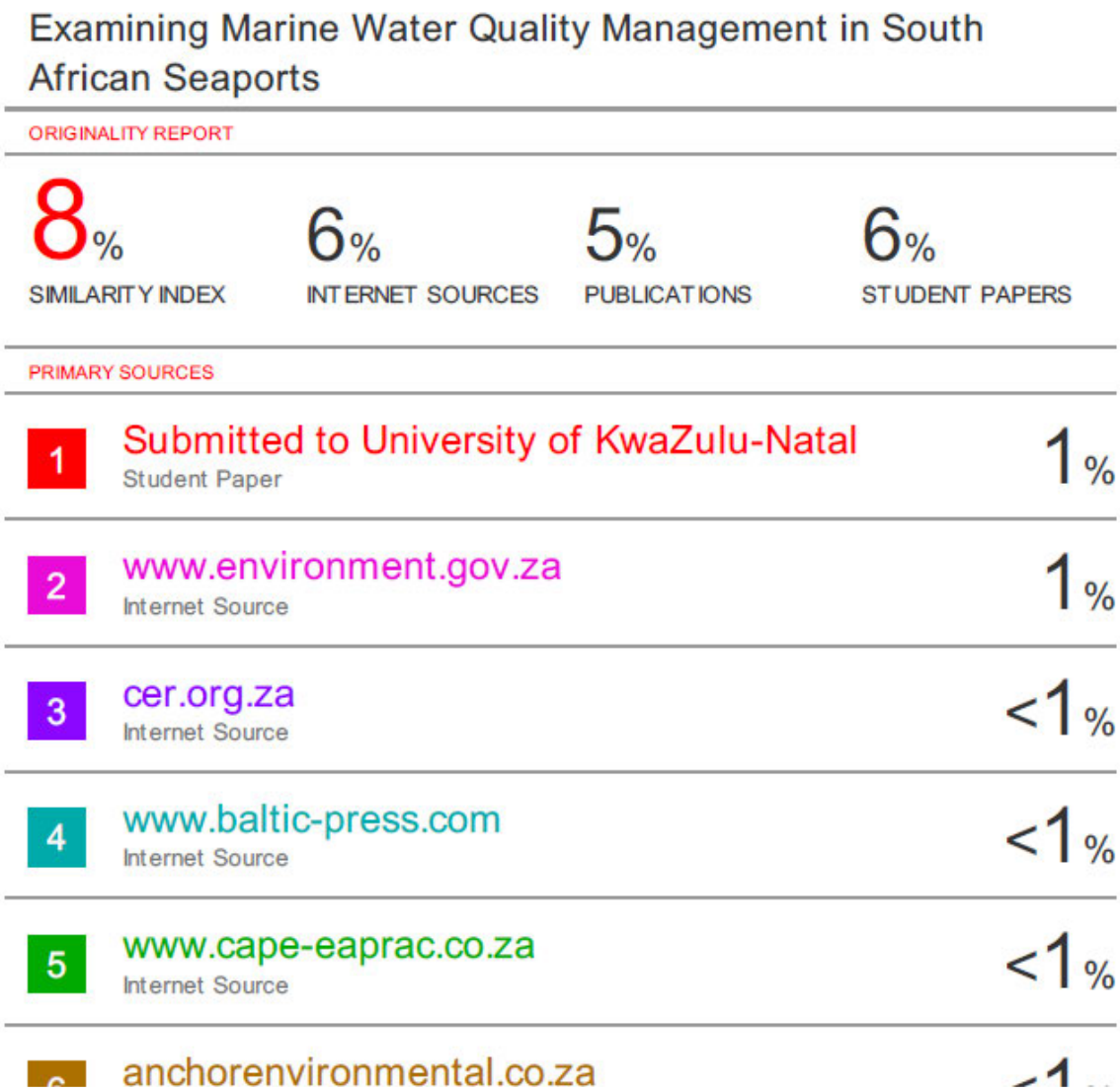
Website: www.ukzn.ac.za

Appendix 5: Turnitin Originality Report



Examining Marine Water Quality Management in South African Seaports

ORIGINALITY REPORT

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