

https://dspace.org/

Effective impact prediction: how accurate are predicted impacts in EIAs?

Molefe, Noella Madalo

2017

http://hdl.handle.net/10539/23570

Molefe, Noella Madalo (2017) Effective impact prediction: how accurate are predicted impacts in EIAs?, University of the Witwatersrand, Johannesburg, <http://hdl.handle.net/10539/23570>

Downloaded from a DSpace repository. https://dspace.org/

Effective Impact Prediction:

How accurate are predicted impacts in EIAs?

NOELLA MOLEFE (448899)

SUPERVISOR: DR. U. SCHWAIBOLD

SCHOOL OF ANIMAL, PLANT & ENVIRONMENTAL SCIENCES

A Dissertation submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science.

DECLARATION

I declare that this Dissertation Report is my own, unaided work. It is being submitted for the Degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

_____

(Signature of candidate)

_____day of _____20_____in_____

ABSTRACT

An Environmental Impact Assessment (EIA) is an instrument used to limit unexpected and negative effects of proposed developments on the environment. Much experience has been gained internationally but the lack of follow-up after the EIA is prepared is one of the major weak spots of the assessments. It is therefore very important to follow up on development projects and observe their effects on the environment after the go-ahead has been given, so that the EIA quality may be improved. There is often a significant difference between predicted impacts and actual impacts. Sometimes the predicted impacts do not occur, or new impacts which were not predicted in the Environmental Impacts Assessment Reports (EIRs) arise. The aim of this study was to assess the accuracy of the impacts predicted in the EIRs compiled for three large-scale Eskom projects currently under execution situated in the Mpumalanga, Limpopo and KwaZulu-Natal provinces by comparing them to the actual impacts that occurred on site. The EIA follow-up process was used to assess the influence that the EIA may have on large-scale projects and ultimately assess the effectiveness of the EIA process as a whole. A procedure developed by Wilson (1998) was used to follow up on the selected projects because the method allowed for comparisons between the actual and predicted impacts to be made and for discrepancies in the EIRs to be identified. Recent audit reports, aerial photographs and interviews were all used to identify actual impact occurrence. Of the impacts which actually occurred, 91% occurred as predicted (OP) and 9% occurred but were not predicted (ONP). The majority of impacts omitted from the reports were hydrological (27%) and air quality impacts (25%). These unexpected impacts were most probably overlooked because they are site-specific, temporary in nature and would not cause any significant environmental damage. Of all the impacts predicted in the reports, 85% were accurately predicted and 15% were not. The impacts inaccurately predicted were hydrological impacts (27%), flora and fauna impacts (7%) and 30% other impacts which included soil pollution, fires and loss of agricultural potential. The inaccuracies could be a result of Environmental Impact Assessment Practitioners (EAPs) predicting a large number of impacts with the hopes of lowering the risk of omitting impacts. However, sometimes the impacts predicted do not occur in reality. Overall it can be concluded that the impact prediction accuracy of the three EIRs compiled for Eskom exceeds previous studies conducted nationally. Eskom EIRs are highly accurate with regards to impact prediction with minor discrepancies which can easily be rectified.

Key words: *Environmental Impacts Assessment (EIA) Environmental Impacts Assessment Reports (EIRs), Environmental Impact Assessment Practitioners (EAPs), EIA follow-up, discrepancies.*

ACKNOWLEDGEMENTS

I would like to thank all the people who contributed directly and indirectly to this research.

I am particularly grateful to all the environmental practitioners I interviewed for their time and cooperation, my supervisor Dr Ute Schwaibold for her guidance and patience. My husband Christopher Molefe and family for their support and for giving me strength during my hardest times. Lastly, I would like to thank my loving daughter, Dintle Molefe for being my motivation and my reason to never give up.

CONTENT

DECLARATION ..... **II**

ABSTRACT ..... **III**

ACKNOWLEDGEMENTS ..... **IV**

LIST OF FIGURES AND TABLES ..... **VII**

ACRONYMS & ABBREVIATIONS ..... **VIII**

CHAPTER ONE: INTRODUCTION **9**

1.1 PROBLEM STATEMENT **10**

1.2 RESEARCH AIM AND OBJECTIVES **11**

1.3 RESEARCH REPORT STRUCTURE **11**

CHAPTER TWO: LITERATURE REVIEW **12**

2.1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) **14**

The EIA process 14

EIA process in South Africa 17

Legislative context of EIAs in South Africa 19

2.2 EIA EFFECTIVENESS AND EIA FOLLOW-UP **21**

EIA follow-up in practice 24

2.3 EIA FOLLOW-UP IN SOUTH AFRICA **26**

CHAPTER THREE: RESEARCH METHODOLOGY **29**

3.1 COMPANY BACKGROUND **29**

3.2 METHODS FOR DATA COLLECTION **29**

Kusile Power Station 31

Medupi Power station 31

Ingula Pumped-storage scheme 32

3.2.2 STEPS 2 AND 3: IDENTIFY LIKELY PROJECT IMPACTS AND PRIORITISE **32**

3.2.3 STEP 4: IDENTIFY PROTOCOLS FOR FIELD INVESTIGATIONS (INCLUDING INTERVIEW SCHEDULES) **33**

3.2.4 STEP 5: COMPARE ACTUAL IMPACTS TO PREDICTED IMPACTS **34**

3.2.5 STEP 6: DETERMINATION OF CAUSE OF ERROR & DATA ANALYSIS **35**

3.3 LIMITATIONS TO THE STUDY **35**

CHAPTER FOUR: RESULTS **36**

4.1 PREDICTED VERSUS ACTUAL IMPACTS **36**

4.2 INTERVIEWS **41**

CHAPTER FIVE: DISCUSSION AND CONCLUSION **42**

5.1 PREDICTED VERSUS ACTUAL IMPACTS 42
Discrepancies identified in EIRs 44
Value of EIA follow-up 45
5.2 RECOMMENDATIONS 46
5.3 CONCLUDING REMARKS 47
REFERENCES 49
APPENDIX A: AERIAL PHOTOGRAPHS 56
APPENDIX B: QUESTIONAIRES 59
APPENDIX C: ACTUAL IMPACT OCCURRENCE 62

LIST OF FIGURES AND TABLES

FIGURES

Figure 2.1 Generic EIA process (Youthed, 2009)....16
Figure 2.2 South African EIA process (Youthed, 2009)....18
Figure 3.1 Six steps adapted from Wilson (1998) used to conduct EIA follow-up....30
Figure 4.1 Percentage of actual impact occurrence for all projects....36
Figure 4.2: Percentage of impacts predicted for all projects....37
Figure 4.3: Percentage of actual impact occurrence per impact category....38
Figure 4.4: Percentage of impacts predicted per impact category....38
Figure A1: Aerial photographs of Kusilie PS in 2004 and 2016....56
Figure A2: Aerial photographs of Medupi PS in 2005 and in 2016....57
Figure A3: Aerial photographs of Ingula PSS in 2008 and 2016....58

TABLES

Table 4.1: Summary of the impacts which did not occur as predicted....40
Table C1: Kusile PS actual occurrence ratings with comments from the site observations and interviews....62
Table C2 Medupi PS actual occurrence ratings with comments from the site observations and interviews....65
Table C3: Ingula PSS actual occurrence ratings with comments from the site observations and interviews....70

.

ACRONYMS & ABBREVIATIONS

CA	Competent authority
CEMP	Construction Environmental Management Plan
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DMR	Department of Minerals and Resources
DWAS	Department of Water & Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioners
ECA	Environmental Conservation Act
EIA	Environmental Impact Assessment
EIR	Environmental Impact Assessment Report
EMP	Environmental Management Plan
I&AP	Interested and Affected Parties
LN	Listing Notice
NEMA	National Environmental Management Act
NWA	National Water Act
RoD	Record of Decision

CHAPTER ONE: INTRODUCTION

An Environmental Impact Assessment (EIA) is an instrument used to limit unexpected and negative effects of proposed developments on the environment. It is one of many tools used in environmental management to prevent pollution and loss of biodiversity (Georgeades, 2012). Globally, EIA effectiveness and its role in achieving sustainable development has been widely debated (Cashmore *et al*., 2004; Georgeades, 2012). Much experience has been gained internationally and many authors have noted that EIA effectiveness is reduced by weak or the lack of follow-up after the EIA is prepared (Arts, 1998; Ndlovu, 2015). EIA follow-up is a term used to describe all the activities which occur post-decision and during the implementation stages of the project such as but not limited to, monitoring and auditing (Ahammed and Nixon, 2006). All these activities relate to feedback, which develops an understanding of the actual impacts of the development on the environment (Georgeades, 2012). EIA follow-up is a practical method of assessing the EIA impact prediction accuracy, thus improving the credibility of the EIA as a whole (Ahammed and Nixon, 2005). This process should be conducted by independent environmental practitioners post decision-making to ensure that the identified environmental controls stipulated in the Environmental Management Plan (EMP) are implemented and effective at minimising environmental damage (Achieng Ogola, 2009).

Often EIAs place more emphasis on the stages leading up to the Environmental Authorisation (previously referred to as a Record of Decision) from the relevant authority and less on the auditing and monitoring of the impacts likely to occur throughout the construction and operation phases, making the process appear to be no more than a pre-decision analysis (Arts, 1998). As a result, the construction and operation practices are often found to be inconsistent with the earlier recommendations and commitments stipulated in the EIA (Morrison-Saunders *et al.*, 2001). EIA follow-up is considered to have many benefits which include learning from prediction accuracy, recognising surprises, managing uncertainties and risks and enhancing positive effects (Jalava, 2014). EIA follow-up is done to check and adjust the preparation of the EMP reports and to fill in the gaps in knowledge (Jalava, 2014). However, EIA follow-up is not frequently or efficiently conducted and this could be a result of deficiencies in the EMPs/EAs or deficiencies in monitoring and compliance enforcement (Achieng Ogola, 2009). Other possible reasons include the lack of policy priority, external pressure, surveillance and sanctions. Its track record is particularly poor due to the lack of practitioners conducting site visits after construction due to financial, personnel and time constraints (Arts *et al.*, 2001). There is a very poor history of visiting the site to check whether the impacts were predicted correctly, if the impacts were as significant as predicted or if the proposed

mitigation measures and management processes are adequate or may need to be reviewed. Little effort is made to analyse the actual effects of the activities described in the EIA (Arts *et al.,* 2001). It is therefore very important to follow up on the projects and observe the effects on the environment after the go-ahead has been given, so that the EIA quality may be improved (Achieng Ogola, 2009). Improving the EIA quality would improve EIA effectiveness which is vital as there is a wide reliance on the EIAs for environmentally sustainable development (Georgeades, 2012).

1.1 PROBLEM STATEMENT

The concept of EIA follow-up has received considerable attention in the recent years. Literature reveals that there seems to be a lack of EIA-follow up worldwide and this has in turn compromised the effectiveness of the EIA as a tool for safeguarding sustainable development (Gwimbi, 2016). EIA entails making predictions about the future and is prone to fallacy and error (Georgeades, 2012). Often there is a significant difference between predicted impacts and actual impacts. Sometimes the predicted impacts do not occur, or new impacts which were not predicted in the EIAs arise (Tennoy *et al.*, 2006). Inaccuracies in EIA impact identification and predictions are common because environmental consultants are required to assess variables that are difficult to predict. Often they are given limited time and little information and are required to predict possible impacts and provide mitigation measures and monitoring plans for them (Cele, 2016). Therefore inaccuracies and uncertainties in impact prediction are not surprising but can be improved through EIA follow-up after the documentation has been completed and submitted (Morrison-Saunders *et al.*, 2001).

In South Africa ineffective environmental management could be attributed to the lack of successive EIA follow-up to ensure the accuracy of predicted impacts and compliance to mitigation/management plans. These two aspects are vital to post-decision actions and subsequently determine the effectiveness of EIAs in South Africa (DEAT, 2008). It is important to understand that ultimately it is the actual impacts that are relevant for protecting the environment and knowing the actual impacts may improve environmental management in general and foster the notion of sustainable development in South Africa. Therefore, this study focused on EIA impact prediction accuracy and a critical discussion around the value of the EIA follow-up as a management tool in protecting the environment.

1.2 RESEARCH AIM AND OBJECTIVES

The aim of this study was to assess the accuracy of the impacts predicted in the Environmental Impacts Assessment Reports (EIRs) compiled for three large-scale Eskom projects by comparing them to the actual impacts that occurred on site. The findings were included in a review of the value of the EIA follow-up process as a management tool.

The objectives were to:

- identify the predicted environmental impacts listed in the final EIRs of three Eskom projects in Mpumalanga, Limpopo and Kwazulu-Natal provinces that are currently under execution;
- critically assess the EIA compliance audit reports and aerial photographs to identify actual impacts;
- conduct interviews to identify actual impact occurrence and to get a view of s attitudes towards the EIA and EIA follow-up process;
- compare the actual impacts to the predicted impacts.

This information contributed to a greater literature review of impact prediction accuracy in EIAs in South Africa and globally, and the challenges related to EIA follow-up.

1.3 RESEARCH REPORT STRUCTURE

The dissertation is structured into five (5) chapters. Chapter 1 provides a brief introduction to EIAs and EIA follow-up and provides a rationale for focusing on impact prediction in the EIAs. It also outlines the aim and objectives of the study. Following the introduction is the literature review in Chapter 2. This chapter discusses the relevant literature by giving a theoretical perspective of EIA, EIA follow-up and the link it has to EIA effectiveness. Chapter 3 discusses the research process and methodological approaches used. The results are presented in Chapter 4, while Chapter 5 discusses, reflects and considers the literature review and findings to address the research aim. It also presents concluding remarks and provides recommendations for improving future studies and the EIA practice.

CHAPTER TWO: LITERATURE REVIEW

Effective environmental management is currently a global challenge. In order to meet social and economic development needs, the environment is often disregarded. Human activities have an adverse effect on the surrounding environment and may cause serious ecological damage. Often the environment is exposed to pollution (land, water, and air) to achieve development targets. For example, South Africa relies heavily on the burning of fossil fuels in order to generate electricity. Such activities have harmful consequences on the environment which include air pollution as a result of high greenhouse gas emissions (IPCC, 2007). In the process waste is produced, contaminating the land and soil. Large-scale developments have the potential to pollute or completely destroy watercourses such as wetlands and rivers. Sprawling cities and developments are also capable of significantly degrading or fragmenting natural habitats, resulting in a loss of biodiversity and soil erosion (IPCC, 2007). This in turn severely affects the human population as many people in South Africa rely on the natural resources such as clean water and arable soil for their livelihoods, leaving them vulnerable to and most affected by environmental damage caused by developments. It is therefore vital for human activities and developments to be environmentally, socially and economically sustainable in order to keep the balance (IPCC, 2007).

Sustainable developments can be defined as "*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (World commission on Environment and Development, 1987, 41). Sustainable development has evolved steadily over the last three decades in response to the increase in developments and industrialisation (Cele, 2016). Today, development is driven by our current needs without considering the future impacts. Economic growth is a prerequisite for sustainable development and is measured with indices such as the Gross Domestic Product (GDP); however this favours infrastructure development and completely ignores the quality of the environment, food security and education (Myers and Kent, 2005; Georgeades, 2012). In order to apply effective environmental management, more emphasis needs to be placed on balanced sustainable growth in South Africa (Georgeades, 2012). Social, environmental and economic factors need to be balanced to achieve sustainable development (Cele, 2016). According to the South African Constitution, promoting economic or social development should not be detrimental to the environment; ecological sustainable development should also be secured (Aurecon, 2015). If we do not pursue sustainable methods of development, severe and more frequent consequences are likely to arise and negatively affect our environment and human health (Giddings *et al.,* 2012). South Africa has committed itself to the pursuit of the United Nations Millennium Development Goals for 2015 (Georgeades, 2012).

These goals include environmental sustainability and the responsible management of the natural environment, such as safe water supplies and sanitation (Georgeades, 2012). South Africa is a developing country and for this reason effective management of the natural environment is essential. It is therefore necessary to understand what environmental sustainable development is and the how it may be pursued and improved (Georgeades, 2012).

Most governments around the world have developed tools in order to promote sustainable development, these tools include environmental taxes and levies, subsidies and most importantly laws and regulations that control environmental pollution and regulate development (Giddings *et al.,* 2012). These laws prohibit harmful environmental practices such as air and water pollution caused by industries, or developing on sensitive land. Most developed countries have advanced environmental laws that protect the environment and all natural resources; however developing countries such as South Africa are still in the process of incorporating all the environmental laws into all development processes (Achieng Ogola, 2009).

The National Environmental Management Act (107 of 1998) was established in South Africa to ensure that development is economically, socially and environmentally sustainable. The principal aim of this Act is to enable co-operative environmental governance by developing principles to protect the environment (RSA, 2010). To promote the sustainable use of resources and sustainable development processes, many environmental assessments and management processes are currently being applied. These tools include: Strategic Environmental Assessments (SEA), which provide information about the environment and the socio-economic impacts (Rossouw *et al.,* 2000); Environmental Management Frameworks (EMF), which study the biophysical and socio-cultural systems of geographically defined areas (NEMA 2010); Environmental Management Programmes (EMP) which provide details on how mitigation measures and management plans should be implemented (Lochner, 2005); Environmental Management Systems (EMS) which enable organisations to increase operating productivity and reduce their environmental footprint (EPA, 2016) and Environmental Risk Assessments (ERA) which provide methods to predict potential risks to human health or the environment (Dantes, 2016). However, the most widely used assessment tool is the Environmental Impact Assessment (EIA). EIAs have both advantages and disadvantages with regards to the role they play in achieving sustainable development.

2.1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

An Environmental Impact Assessment (EIA) is a legislated tool used to assess different factors associated with human and environmental health. It evaluates the effects that a major project is likely to have on the environment (Bartlet, 1988; Wood, 1999). According to NEMA (1998) the environment is defined as the surroundings within which humans exist and that are made up of the land, water, atmosphere, micro-organisms, plant and animal life. It also includes the physical, chemical, aesthetic and cultural properties that influence human health and wellbeing. The EIA can be defined as "the process of identifying, predicting, evaluating, and mitigating the biophysical, social and other relevant effects of development proposals prior to major decisions being taken and commitments made" (Senécal *et al*., 1999, p.2). It is an integrative and participatory environmental management process done for new and expansion projects/activities where the impacts are unknown (Achieng Ogola, 2009). The EIA procedure ensures that all the consequences of a development are taken into consideration during the early design and planning stages (Glazewski, 2005). The main objectives of an EIA are to (Jordaan, 2010):

- improve environmental decision quality;
- assist in managing projects;
- improve consent procedures, and
- increase environmental awareness.

The EIA process

The EIA process plays a vital role in environmental management and is being practiced internationally (Morrison-Saunders and Fischer, 2006). The EIA process may differ between countries; however the process has a common structure with essential steps to be followed. Figure 1.1 shows the basic EIA process structure (United Nations University, 2006). Screening is done to determine if it is necessary to conduct a full EIA or a Basic Assessment (BA) (UNEP, 2002). Once the decision on the level of assessment is made, scoping is required to determine the main issues of concern to be investigated, in order to avoid exhaustive studies on all possible impacts (UNEP, 2002). Impact analysis is the process of analysing the current environmental baseline conditions and making suitable environmental impact predictions in terms of their nature, magnitude, likelihood, duration and significance (UNEP, 2002). Effective mitigation measures and management plans are then put in place to avoid, minimise or compensate for significant negative environmental impacts (Achieng Ogola, 2009). Proposed mitigation measures should address how expected and unexpected impacts will be managed throughout the development process (UNEP, 2002). An Environmental

Impact Assessment Report (EIR) is then compiled after all the necessary investigations have been conducted (Weaver, 2003). After the report has been received by the decision-making authority, the report is reviewed in order to ensure that it is adequate for an informed decision to be made (UNEP). Thereafter, a decision is made on whether the project may continue or not (UNEP, 2002). Conditions are set in an Environmental Authorisation (EA) and form the framework for management. Upon project commencement the various conditions stipulated in the EA and Environmental Management Plans (EMPs) require implementation (Weaver, 2003) and regular follow-up in the form of monitoring and auditing (UNEP, 2002).

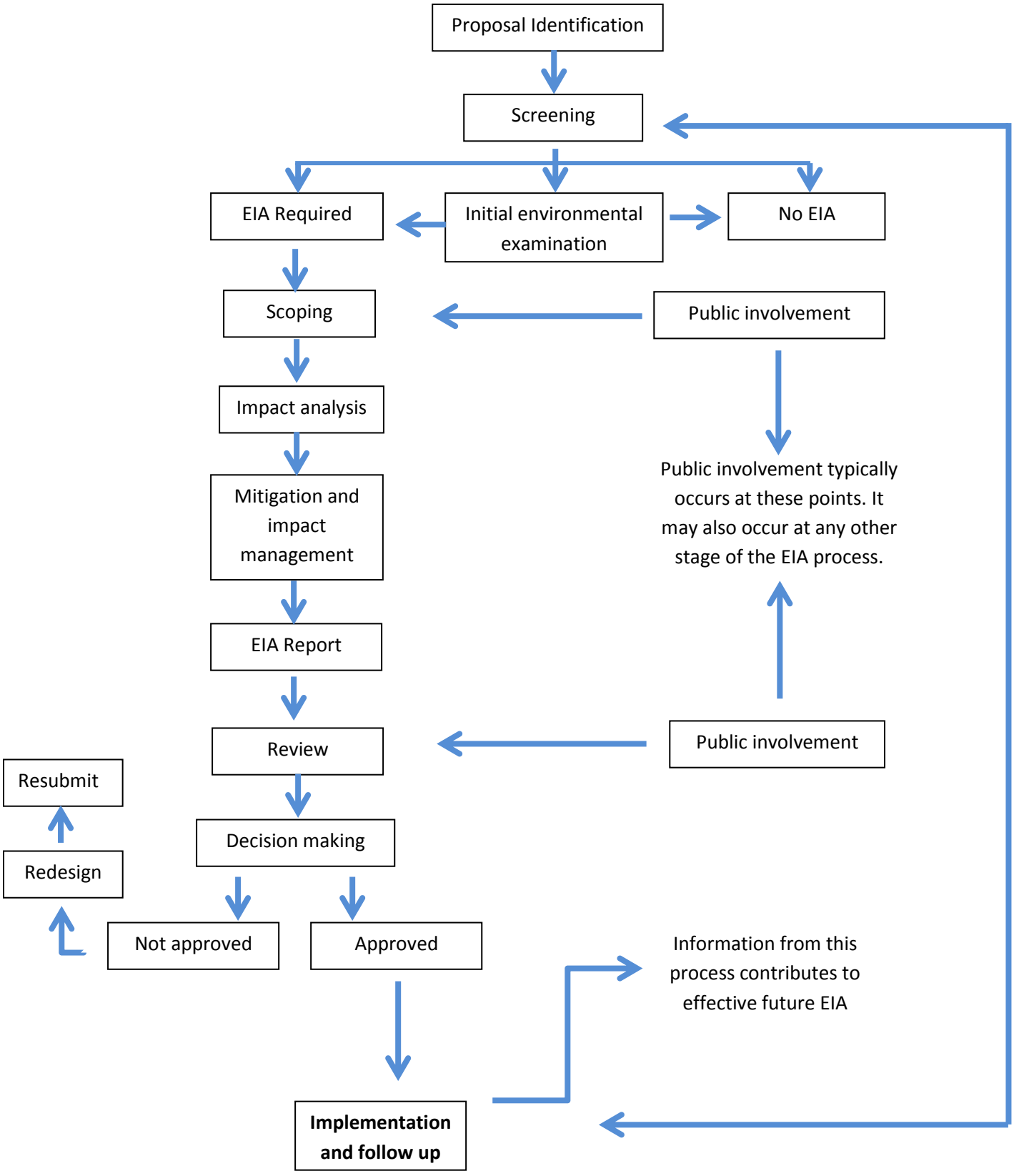


Figure 2.1 Generic EIA process (Youthed, 2009)

EIA process in South Africa

The Environmental Impact Assessment (EIA) regulations became a statutory requirement in South Africa in September 1997 as part of the Environment Conservation Act, 107 of 1989 (Act 73 of 1989), and later the National Environmental Management Act, 1997 (Act 107 of 1997) (NEMA) (Glazewski, 2005). Before then it was done as a voluntarily practice for large scale projects only (Duthie, 2001). The South African EIA process is very similar to the generic EIA process; however it has a few unique changes (Youthed, 2009; see Figure 1.2). Screening is guided by legislation as well as by regulatory authorities' discretion (Youthed, 2009). The EIA regulations (RSA, 1997a) include a list of activities that require environmental assessments and identify type of assessment required (EIA or BA). However, provincial authorities may also determine the depth of the assessment required based on their own discretion (Wood, 1999). Scoping in South Africa is defined as "the process of identifying the significant issues, alternatives and decision points which should be addressed by a particular EIR, and may include a preliminary assessment of potential impacts" (DEAT, 2008). Public participation in South Africa plays a vital role in the scoping process and is evident in practice, making it different from the generic EIA process. Impact assessment and mitigation are often combined with the scoping process and treated as a "mini-EIA". Unfortunately, according to Wood (1999) and Kruger and Chapman (2005), the quality of reporting is often poor, even though what the report should contain is outlined in the EIA regulations (RSA, 1997b). The authorities then review the reports to determine if there is sufficient information to make a comprehensive decision and if the requirements (legal and procedural) have been met. Thereafter, the relevant authorities either authorise the project with or without conditions or deny it completely (Youthed, 2009). An EA is then issued with project-specific information, conditions of authorisation and means of appeal (Youthed, 2009). The authorities stipulate conditions to be adhered to in the EAs and/or require EMPs to be submitted, however the effectiveness of this is unknown (Youthed, 2009).

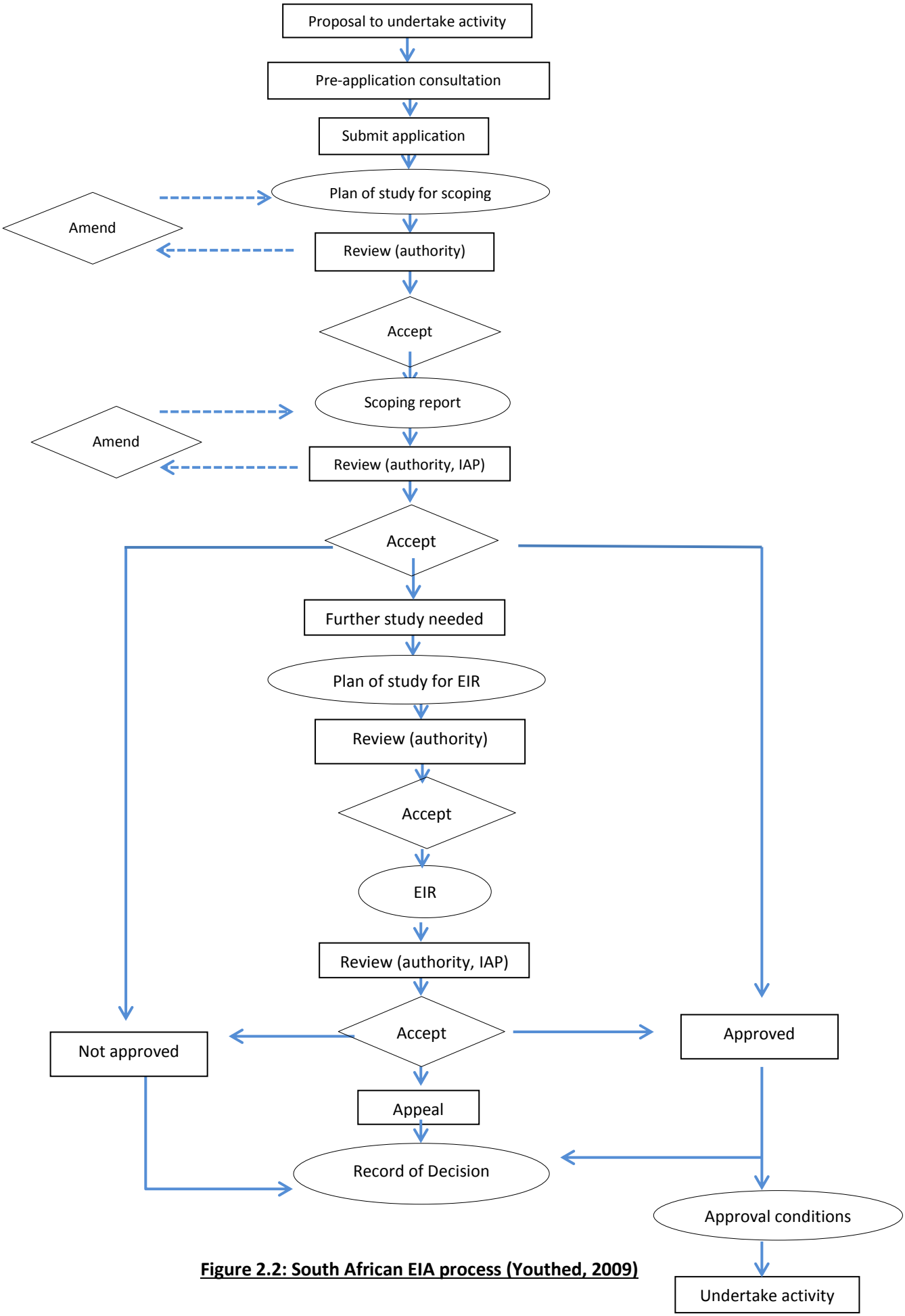


Figure 2.2: South African EIA process (Youthed, 2009)

Legislative context of EIAs in South Africa

Environmental management is mentioned in several South African Acts; therefore the intention of this section is to highlight specific legislation relevant to the study. The Constitution of South Africa applies to everyone in South Africa (RSA, 1996). However, only two issues in the Constitution are important for environmental management. Firstly, Section 24 of the Constitution mentions the right of all persons to an environment that is not harmful to their health as a basic right. Secondly the Constitution also makes provision for the administration of environmental matters (RSA, 1996). The Environmental Conservation Act 73 of 1989 (ECA) was to a great extent replaced by the National Environmental Management Act (NEMA), however it is the primary Act under which the EIA's assessed in this study were conducted. It provided the legislative framework and guided the EIA processes by 1) making provision for the identification of activities that could have negative impacts on the environment (RSA, 1989: Section 21); and 2) ensuring that such activities are assessed for their significance and authorised before the project begins (RSA, 1989: Section 22).

The EIA regulations were only published in terms of ECA in 1997 (RSA, 1997c). The listed activities (activities which are likely to have potentially significant negative impacts on the environment) and the regulations governing the environmental impact assessment process were published in the Government Gazette No 18261, Notice R.1182 and No. R. 1183 on the 5th November 1997. Minor amendments were then published thereafter. They represent the activities which were subject to the EIA process for the projects in this study. Unfortunately the EIAs conducted according the ECA regulations had many shortcomings such as the lack of monitoring and auditing, the lack of environmental management provisions, limited and vague description of listed activities (Wood, 1999).

The National Environmental Management Act 107 of 1998 (NEMA) gives South African citizens the right to an environment which is protected. The act also provides governance and the control of activities which may have a negative impact on the surrounding environment (RSA 1998). The aim of the Act is to provide a framework for sustainable environmental management (RSA 1998). The EIA regulations which form part of NEMA were gazetted on the 21st of April 2006 (RSA, 2006) in order to address the shortcomings of the ECA regulations. The regulations were amended several times with the goal of improving the effectiveness of the EIA process. When compared to the EIA regulations under ECA, the NEMA 2006 EIA regulations had the following changes (Youthed, 2009):

- the regulations described the listed activities that required a basic assessment (R386) and those that required a full EIA (R387);
- roles and responsibilities were refined (set specific timeframes for the authorisation process and introduced the concept of independent environmental consultants);
- made provision for the enforcement of conditions and on post-authorisation management mechanisms (i.e. EIA follow-up).

The NEMA 2010 EIA regulations replaced the NEMA 2006 EIA regulations and the related listing notices; and had the following changes:

- They provided the environmental authorisation process of activities requiring a BA (Listing Notice (LN) 1, R544) and activities that required scoping and EIA (LN 2, R545). It also provided a list of activities that required environmental authorisation (EA) if carried out in specific geographical areas (LN 3, R546);
- included Environmental Management Frameworks (EMF) (R547);
- stipulated specific EIA application time frames.

The NEMA EIA regulations were revised for the third time in 2014 with the changes below:

- they enforce consistency among all competent authorities (CA) for processing and reviewing EIAs as well as for decision-making;
- a clearer balance of responsibilities between all parties is provided;
- the EIA process with the inclusion of exemptions and appeal regulations is described;
- the EIA timeframes to be used by the Department of Minerals and Resources (DMR), Department of Water and Sanitation (DWAS), Department of Environmental Affairs (DEA) and all provinces are also clearly defined (RSA, 2014);
- detailed guidelines on the EA and EMP auditing process and frequency, which may encourage regular follow-ups to be conducted, are also provided;
- the regulations require a more detailed plan addressing financial provisions available for rehabilitation, environmental liability and closure plans (Alers, 2016).

This study focused on projects carried out while the ECA 1997 EIA regulations were in effect and when EIA follow-up was not a requirement. However, the implications of this change are not expected to have a great impact on the findings as the underlying principles of the EIA remain the same in both regulations and the EAs were amended to address EIA follow-up in accordance with the NEMA regulations.

2.2 EIA EFFECTIVENESS AND EIA FOLLOW-UP

The Environmental Impact Assessment (EIA) is a well-established and well-practiced environmental management tool, however the EIA process has caused a considerable debate over how well it can achieve its main purpose (Jay *et al.,* 2007). EIAs are measured by their 'effectiveness' which refers to the ability of the EIA to identify, assess, mitigate and/or prevent adverse impacts and enhance positive impacts on the environment (Sandham and Pretorius, 2008). The EIA process has many limitations and the effectiveness of the process is often questioned (DEAT, 2008; Jordaan, 2010; Ndlovu, 2015). An effective EIA must assist or improve environmental management and ensure environmental protection (Sandham and Pretorius, 2008). According to Cashmore *et al*. (2004), while the EIA process has limitations, it also has the potential to promote and contribute to sustainable development in many ways that may be underestimated.

Unfortunately, EIA effectiveness is still not well understood and there is a growing dissatisfaction over the influence that the EIA process has on developments (Jay *et al*., 2007). The EIA is seen as unsubstantiated because impacts are predicted and not actually measured. It is also seen as a tick-box exercise because the assessed sites are not revisited post-decision making and often the development continues despite the harmful effects it may have on the environment and society (Cashmore *et al.,* 2004). However, the Department of Environmental Affairs initiated a study to evaluate the effectiveness of the EIA process in 2006 and found that the EIA effectiveness was marginal. Some of the issues raised during the assessment were that the EIA is more focussed on procedure and administration and less on sustainability; that Environmental Assessment Practitioners (EAPs) are appointed by the applicant and not the government which could lead to bias; public participation was not meaningful; there was a lack of compliance monitoring and reviewing of assessment documents was inconsistent due to lack of capacity (DEA, 2013). Many of the issues raised during the assessment have been addressed in the most recent EIA regulations in order to improve EIA effectiveness. Most importantly, EIA follow-up has been included in the EIA regulations and EIA procedures to ensure compliance to conditions and improvement in EIA effectiveness.

During the EIA process, environmental consultants are required to assess variables that are difficult to predict. Often they are given limited time and little information and are required to predict all possible impacts and provide mitigation measures and monitoring plans for them before the project is even implemented (Arts, 1998). Such a process deals with uncertainty which can only be reduced by EIA follow-up. EIA follow-up is conducted to check and adjust the preparation of

reports, fill in the gaps in knowledge and reduce uncertainties (Arts, 1998). EIA follow-up is the single term used to describe all the activities that are conducted after the EA is granted by the relevant authority (Youthed, 2009). However, many other terms are also used to describe these activities, e.g. "*ex post* evaluation" (Arts *et al*., 2001), "*post hoc* assessments" (Serafin *et al*., 1992), "auditing" (Sampson and Visser, 2004) and/or "post auditing" (Dipper *et al*., 1998). These terms may be confusing and contradictory; hence the commonly accepted term is 'EIA follow-up' which encompasses all the activities conducted after the EA has been granted and has been used in this study.

In order to determine the effectiveness of the EIA process, the content of the EIA should be validated on a regular basis. Unfortunately, systematic evaluations of the actual impacts versus the predicted impacts and studies on the influence of the EIA on development projects are rare (Morrison-Saunders and Arts, 2004). However, this study used the follow-up process in order to assess the influence the EIA may have on large-scale developments. EIA follow-up is regarded as a method of monitoring, evaluating, managing and communicating a project's impacts post-development (Morrison-Saunders and Arts, 2004). It includes the monitoring of actual impacts (as compared to the predicted impacts) and enforcing compliance to commitments and conditions stipulated in the EA (Ndlovu, 2015). EIA follow-up should begin once the EA has been granted (Ndlovu, 2015). The main purpose of EIA follow-up is to improve environmental protection measures during project implementation and to enhance feedback on the EIA process, thus improving EIA practice and systems (Morrison-Saunders, 2003). The goal of the EIA follow-up is to minimise negative impacts and to ultimately safeguard the environment (Marshall *et al.,* 2005).

There are four elements of EIA follow-up, namely: monitoring, evaluation, management and communication (Arts *et al.,* 2001). Monitoring is the collection and recording of data over a period of time for a specific purpose. It also includes collecting information or measurements and comparing data with predictions. The main types of EIA monitoring activities include: 1) baseline monitoring to measure the baseline conditions pre-project; 2) effect/impact monitoring to measure the environmental changes during construction and/or operational phases and to check the effectiveness of mitigation measures; 3) compliance monitoring to ensure compliance to regulatory standards and requirements (UNEP, 2002). Evaluation involves interpreting and assigning meaning to the gathered information. It includes repeatedly examining or auditing objectives over time and comparing the outcomes to standards, predictions or expectations. The main types of EIA audits are impact audits (to detect if an impact has occurred and to estimate its magnitude), compliance audits

(to determine the level of compliance to set conditions) and effectiveness or policy audits (to assess the effectiveness of the EIA process and/or specific policies) (UNEP, 2002). Evaluation also involves some form of judgement (Arts *et al.,* 2001) and the guiding concepts are effectiveness and performance (UNEP, 2002). Management involves making decisions on the issues identified and taking appropriate action to implement responses to matters arising from the monitoring and evaluation activities (Morrison-Saunders and Arts, 2004). Lastly communication is the dissemination of the information and informing stakeholders about results and overall performance (Arts *et al.,* 2001).

EIA follow-up is required in order to verify predictions, ensure compliance to conditions, moderate uncertainty and improve decision making (Ndlovu, 2015). Often the EIA process places more emphasis on the stages leading up to the Environmental Authorisation (EA) and less on the auditing and monitoring of the impacts likely to occur throughout the construction and operation phases, making the process appear to be no more than a pre-decision analysis (Arts, 1998). As a result, the construction and operation practices are often found to be inconsistent with the earlier recommendations and commitments stipulated in the EIA (Morrison-Saunders *et al.*, 2001). EIAs relate directly to the planning and development stages, whereas EIA follow-up relates to the project implementation stages. The main concern is that there is a major gap between predicted impacts and actual impacts, as sometimes the predicted impacts do not even occur. EIA follow-up is therefore described by Morrison-Saunders and Arts (2004, p.7) as the 'link between the pre-and post-decision stages of EIA'. Through EIA follow-up, actual and unexpected impacts can be identified, regulated and corrected where necessary (Cele, 2016). EIA follow-up can also be used to assess the effectiveness of mitigation measures and alter them if they are not effective or not functioning as desired (Youthed, 2009).The level of compliance to commitments and conditions stipulated in the EA may also be monitored and managed through EIA follow-up to make sure that they have been implemented properly (Polonen *et al.,* 2011). EIA follow-up differs from EMP revision or auditing because it incorporates surveillance, monitoring, auditing, evaluation and other tools which allow an ongoing assessment and review of the effects of the development on the environment post-approval (UNEP, 2002).

The EIA follow-up process on its own cannot turn around an environmentally unsound project but it may maximize the returns from the EIR preparation and its consideration in decision-making (UNEP, 2002). EIA follow-up is essential for project proponents as it enables them to gain knowledge about the actual impacts and implement the knowledge gained in subsequent stages of

the project or future projects (Ndlovu, 2015). EIA follow-up findings may also be used as proof of compliance and ultimately improve the project/companies public environmental image (Marshall, 2005). Following up on projects helps manage the risks of future liabilities, reduces costs and improves relationships with stakeholders (communities and regulators) through communication (Ndlovu, 2015). However, EIA follow-up can only be valuable when integrated back into the EIA process (Cele, 2016). Therefore it is essential for the follow-up information to be shared in order to improve future EIA practice.

EIA follow-up in practice

The EIA follow-up process implementation has not been well documented in the literature. According to Morrison-Saunders *et al.* (2003) many countries have EIA follow-up requirement but only a few EIAs are followed up in reality. EIA follow-up is not frequently or efficiently conducted and this could be a result of deficiencies in the EMPs or EAs and/or deficiencies in monitoring and compliance enforcement (Achieng Ogola, 2009). Other possible reasons include the lack of policy priority, external pressure, surveillance and sanctions. Its track record is particularly poor due to the lack of practitioners conducting site visits post-construction due to financial, personnel and time constraints (Arts *et al.*, 2001). There is a very poor history of visiting the site to check whether the impacts were predicted correctly, if the impacts were as significant as predicted or if the proposed mitigation measures and management processes are adequate or may need to be reviewed. Little effort is made to analyse the actual effects of the activities described in the EIA (Arts *et al.*, 2001). It is therefore very important to follow up on the projects and observe the effects on the environment after the go-ahead has been given so that the EIA quality may be improved (Achieng Ogola, 2009).

Many international studies on EIA follow-up can be found, these include a study from Canada which provides guidelines on how to do 'good' follow-up. This study revealed that in 2004, EIA follow-up had not been satisfactorily implemented in Canada (Noble and Macharia, 2004). Another study focused on the generic framework for conducting EIA follow-up and examined the need for follow-up with an emphasis on experience in the Netherlands (Arts and Meijer 2004). A study by Ramjeawon and Beedassy (2004) focused on evaluating the EIA system in Mauritius. One of the main weaknesses was the lack of EIA audits and EIA follow-up (Ramjeawon and Beedassy, 2004). A study in the United Kingdom was conducted to assess whether improving the effectiveness of EIAs is dependent on EIA follow-up (Harmer, 2005). The results suggested that the use of follow-up needed to be extended in the UK in order to improve EIA effectiveness (Harmer, 2005). In a study on EIR predictions accuracy and effectiveness of EIAs in Hong Kong, the results showed that overall

the impacts predicted were reasonably accurate (except for cumulative effects), however some impacts were worse than predicted in the EIA (UNEP, 2002). The EIA effectiveness was also assessed and it was found that not all EIA recommendations were included in contracts, specifications were not specific and compliance enforcement was insufficient (UNEP, 2002). A study conducted by Dipper *et al.* (1998) in the United Kingdom examined the need for post-auditing and highlighted the benefits to future EIA performance if conducted effectively. The study indicated that nearly three-quarters of the auditable impacts were accurately predicted (Dipper, 1998).

General studies on the EIA follow-up benefits and need are the most common in literature (Sadler, 1998; Morrison- Saunders *et al.,* 2001; Morrison- Saunders *et al.,* 2003; Morrison- Saunders *et al.,* 2004). Even though EIA follow-up has been widely legislated and practiced, there is still no set approach on how to practically conduct EIA follow-up and it differs from country to country (Youthed, 2009). There have been calls for EIA follow-up to be conducted in a scientific and rigorous manner (Culhane, 1993), but unfortunately it is not always practical in reality. Assessing predicted impact accuracy is particularly challenging. Nijsten and Arts (2004) proposed a "quick scan" approach to verify impact accuracy by using existing monitoring information, simple field observations and a workshop process to assess major projects. Wilson (1998) proposed that follow-ups start with determining the actual impacts of a project and then looking at what was predicted, after which accuracy can be determined by using simple and practical techniques, e.g. site visits, interviews and field measurements.

EIA follow-up requires adequate resources and capacity in order to conduct comprehensive, scientific and frequent monitoring. Unfortunately, the lack of resources and capacity will affect the quality and type of EIA follow-up process carried out (Morrison-Saunders *et al.,* 2003). A major resource issue is the need for knowledgeable and committed staff (regulatory authority staff, proponents, communities and environmental consultants). The poor work prepared by consultants leads to poor quality EIRs and inadequate EIA follow-up. It is thus of utmost importance that the individuals involved in the EIA process are dedicated and committed to ensuring the success of EIA follow-up. It is also equally important that the persons or environmental team tasked to carry out the EIA follow-up are independent and experienced (Youthed, 2009). Large projects that require long-term commitments, considerable investments and require large areas are more likely to cause significant negative environmental impacts (Youthed, 2009). Consequently, resources for follow-up are usually budgeted for and readily available. On the other hand, smaller projects may not have the resources to implement in-depth follow up procedures. Therefore, EIA follow-up tends to be focused

on larger projects, whereas smaller projects include assuring compliance only (Youthed, 2009). There is bias towards larger projects, however smaller developments should not be ignored as they may also have significant detrimental impacts on the environment which may have a cumulative effect (Slinger *et al*., 2005).

According to Morrison-Saunders and Arts (2004) the EIA follow-up process has many challenges such as uncertainty during the initial EIA prediction stages. This has been confirmed in other post-audit studies which show that actual impacts differ from predicted impacts (Buckley, 1992; Wood *et al*, 2000). The chances of inaccurately predicting impacts are high and they need to be able to provide an estimate of the uncertainty and make the level of uncertainty very clear in the EIA reports (UNU, 2006). There is also a very high risk of over- or underestimating impacts or completely excluding impacts in the EIR. Other challenges include deficiencies in the EAs due to vague impact predictions in the EIR; lack of guidance on how to conduct EIA follow-up; lack of formal legislative requirements, resource and capacity deficiencies (Morrison-Saunders and Arts 2004). Although there are many challenges with the EIA follow-up process, it must be noted that there are equally several positive outcomes of EIA follow-up which include reducing uncertainties, linking the pre- and post-decision stages, monitoring compliance to authorisation conditions and ultimately safeguarding the environment (Jordaan, 2010).

2.3 EIA FOLLOW-UP IN SOUTH AFRICA

EIA follow-up is one of the weakest areas within the EIA system in South Africa (Ndlovu, 2015). Due to the lack of procedures and government pressure, it has been very difficult to incorporate effective EIA follow-up into the EIA process (Marshall *et al.,* 2005). However, according to Ndlovu (2015), the South African government have made efforts to strengthen their focus on environmental compliance and auditing. The ECA regulations (1989) completely neglected EIA follow-up, as compliance monitoring was not a legislated requirement but was only mentioned in the EA conditions. It is clear that EIA follow-up under ECA relied on voluntary or self-regulatory implementation (Alers, 2016). The EIAs also did not require an assessment of the predicted impact accuracy or environmental management effectiveness (Freemantle, 2008). EIA follow-up was incorporated in the 2006 EIA Regulations (NEMA, 1998) in order to enforce compliance monitoring and auditing for all developments. However, a major weakness for the 2006 EIA regulations was that the public participation process focussed on the pre-decision phase of the process and lacked the active engagement of stakeholders in the follow-up process (Alers, 2016). In 2010, the 2006 EIA regulations were amended but had similar weaknesses with regards to EIA follow-up (Alers, 2016).

The public participation process still focused on the pre-decision phases of the process and there was no mention of reporting environmental compliance to the Interested and Affected Parties (I&AP) (Alers, 2016). The 2014 regulations replaced the ECA, NEMA 2006 and 2010 regulations and had a number of improvements which included having to report the environmental management outcomes (including follow-up activities) to the I&AP and continual scoping resulting from the audit findings which could result in the need to amend the EMPr. The NEMA 2014 regulations define follow-up activities more clearly but still have shortcomings as the success of EIA follow-up is still reliant on the competency of the EAP and the authority (Alers, 2016).

In South Africa uncertainty about impact prediction accuracy and the effectiveness of mitigation measures are of particular concern as the previous regulations (ECA) did not provide mandatory provision for monitoring and auditing (Freemantle, 2008). According to Youthed (2009), EIA follow-up is often only conducted in response to urgent need, citizen complaints or if the project is a large scale development project with the potential to have a significant impact on the environment (Youthed, 2009). Little follow-up is actually conducted due to the lack of legal regulations, limited enforcement and insufficient financial resources and/or capacity (Youthed, 2009). However, some studies have been conducted on EIA follow-up in various parts of the country. A study in the Eastern Cape addressed what happens after a consent decision is granted (Youthed, 2009). Follow-up was focussed on assessing the amount of non-compliances to the EA conditions and the overall developments impact on the environment. Overall the study found that follow-up had a positive effect on reducing the amount of defaults and lessened the degree of the impacts on the environment (Youthed, 2009). In another study presented by Freemantle (2008), the aim was to assess the accuracy of predicted impacts and the implementation rate of mitigation measures of activities which received an EA from DEA in the Free State and Northern Cape Provinces (Freemantle, 2008). It was concluded that the predicted impacts were to a large extent accurately predicted and the mitigation measures were successfully implemented (Freemantle, 2008). Jordaan (2010) presented a study focussed on the accuracy of impact prediction and the level of compliance to conditions set out in the EA and EMPs. The study was focused on the construction phases of a high profile mega shopping mall project, namely the Mooi River Mall (MRM) in Potchefstroom. The results showed that a majority of the impacts were predicted accurately and achieved very high compliance to the conditions. Georgeades (2012) presented a study on EIA follow-up during construction as an important indicator of EIA effectiveness. The hypothesis was that EIA follow-up helped to bridge the divide between prediction and reality. The study focused on four case studies in Cape Town and found that the predicted impacts and EMP mitigation measures correlated to a high degree with the actual impacts (Georgeades, 2012). Post-authorisation follow-up and EIA

effectiveness were explored in KwaZulu-Natal province by Cele (2016). It was found that the follow-up procedure and mitigation measures were successfully employed and the environment was protected during development (Cele, 2016). According to the previous studies conducted in South Africa, it can be concluded that impacts in the EIA are generally accurately predicted. Accurate impact predictions result in effective environmental management and protection. Ultimately the questions are: *Which impacts are accurately predicted and why? Which impacts are not accurately predicted and why not?*

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 COMPANY BACKGROUND

In South Africa, Eskom is the largest energy producer and is also one of the main environmental impactors (Eskom, 2011). Eskom developments and activities are often controversial, as the company plays a vital role in the country's development towards alleviating poverty and uplifting societies by improving their standards of living. However, Eskom activities also significantly affect the environment negatively. Hence Eskom needs to ensure that its environmental management is more than just adequate and its environmental footprint is low (Eskom, 2011). Eskom developments are high profile developments and are highly visible to the public. All the required documentation and environmental management initiatives and milestones were easily accessible and for this reason Eskom EIAs were selected for this study.

Eskom was established on the 1st of March 1923 as the Electricity Supply Commission (ESCOM). Since 1923 Eskom has undergone changes and faced challenges such as oversupply crisis, rolling blackouts and electricity price hikes (Greenpeace, 2012). To date Eskom is one of the top utilities globally in terms of generation and sales and it has 27 operational power stations. Eskom aims to diversify the sources of energy and make a meaningful contribution to sustainable energy supply and effective environmental management. Currently, there are no obligations to reduce gas emissions, but South Africa has committed to sustainable development policies and measures such as the Kyoto emissions reduction and Paris targets (Babiker *et al.*, 2000). It is vital for Eskom to balance environmental, economic, financial, operational and social performance imperatives in order to contribute towards sustainable development (Eskom, 2011). Eskom has commissioned a number of new power plants in order to deal with the high demand for electricity and the growing economic development in South Africa (RSA, 2010), and three of the new build projects were selected for this study .

3.2 METHODS FOR DATA COLLECTION

There is extensive literature on EIA follow-up methods; however the published methods follow a more scientific approach in conducting EIA follow-up which has proven to be very difficult in reality. Taking all the challenges of the scientific approach into consideration, Wilson (1998) developed a nine-step procedure for practically following up on EIAs (as seen in Youthed, 2009). Wilson's procedure is a hands-on procedure that is thought to be an "impacts-backwards" method

(starts with observations of actual project impacts before looking back at the EIA predictions) as opposed to the scientific "predictions-forward" method (Youthed, 2009). This informal procedure is not as comprehensive or systematic as the scientific approach but enables EIA practitioners to learn from past mistakes and identify discrepancies in the EIRs (Wilson, 1998). This method was selected because it relies on simple and practical techniques such as site observations and interviews in order to determine the actual impacts after the project has begun (Youthed, 2009). This method also includes comparing project sites with similar sites and photo interpretation (e.g. site and aerial photographs). Most importantly this method allows for comparisons between actual and predicted impacts to be made (Youthed, 2009). Figure 3.1 below illustrates the 6 steps adapted from the Wilson (1998) paper used in the study.

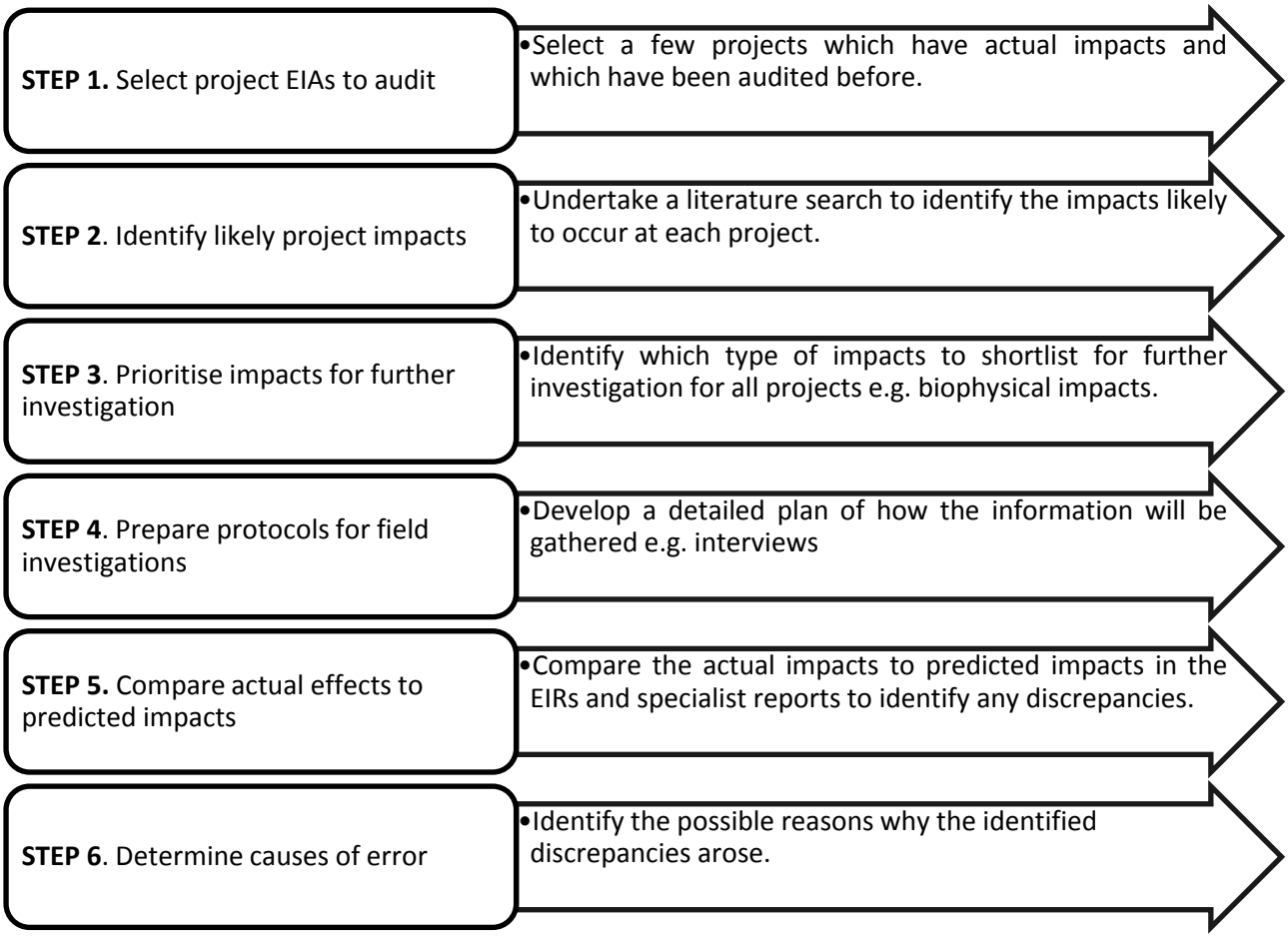


Figure 1.1: Six steps adapted from Wilson (1998) used to conduct EIA follow-up.

3.2.1 STEP 1: SELECT PROJECT EIAs TO AUDIT

The EIRs for two large-scale coal-fired power stations situated in Mpumalanga and Limpopo and a pumped-storage scheme situated in KwaZulu-Natal provinces were selected. These projects were selected because they 1) are new build projects currently under execution (construction and/or early operational phase), 2) have extensive and easily accessible documents and information on the challenges and/or successes encountered, 3) have wide-ranging environmental impacts associated with each project and lastly 4) have been recently audited by external environmental practitioners. The selected EIRs were all prepared by different independent consultants, thus avoiding bias. The focus of the study was on the accuracy of impact predictions and was not a comparative study of the three project types.

Kusile Power Station

Kusile Power Station is a 4800 MW power station situated in the Witbank area (Eskom, 2007). The power station precinct includes the power station building, administrative building and high voltage yard (Eskom, 2007). Upon completion, Kusile power station will be the fourth largest power station in the world. The planned operational life for Kusile power station is 60 years (Eskom, 2013). The NEMA regulations replaced the ECA in 2006, however the EIA commenced under the ECA regulations and was dealt with entirely under the ECA regulations even though the final report was only completed in 2007 (Eskom, 2007). In June 2007 the Department of Environmental Affairs (DEA) issued a positive EA for the construction of the power station and associated infrastructure (Eskom, 2013). However, the EA was appealed and a revised EA was issued in March 2008 (Eskom, 2013). A Waste Management Licence (WML) had to be applied for in 2013 for the co-disposal of ash and gypsum, as gypsum is considered to be hazardous waste (Eskom, 2013). Specialist studies conducted included groundwater and surface water quality studies, aquatic and terrestrial ecological studies and air quality studies.

Medupi Power station

Medupi is a 4800 MW coal fired power station situated in Lephalale, Limpopo (Eskom, 2013). Upon completion the power station will be the biggest dry-cooled power station in the world (Eskom, 2013). The planned operation life for Medupi power station is 50 years (Eskom, 2013). The chosen power station location was previously used for peanut crops and grazing. Baobab trees and many nationally and provincially protected trees were identified prior to construction and were relocated. The EIA was undertaken in terms of the ECA regulations and required authorisation from

DEA in consultation with the Limpopo Department of Economic Development, Environment and Tourism (LEDET) (Eskom, 2006). A positive EA was issued by DEA in 2006 and a revised EA was issued in May 2007. Wide-ranging and independent studies were undertaken in accordance with the EIA regulations to identify all potential environmental impacts (Eskom, 2006). Construction commenced in May 2007.

Ingula Pumped-storage scheme

The Ingula pumped-storage scheme is situated in KwaZulu-Natal province (Eskom, 1999). The scheme consists of an upper (Bedford) and lower (Braamhoek) dam which are 4.6km apart (Eskom, 2016). The dams are connected by underground waterway tunnels passing through a power house with 4 generators. During times of peak demand, water is released from the upper dam to the lower dam and passes through the pump/turbines to generate electricity. During low energy demand the water is pumped back to the upper dam with the aid of the pump/turbines (Eskom, 2016). The area surrounding the dams serves as a habitat for a variety of plants, birds and animals and therefore the area is managed by Eskom as a conservation area. There are also wetlands which supply the Wilge River and surrounding springs. The wetlands are in need for protection as they host a variety of species. Eskom lodged an application for an EA with DEA for the Ingula Pumped storage scheme (Braamhoek Pump storage) in terms of ECA regulations. The EIA was published in 1999 and an EA was issued in 2002 authorizing the project. Thereafter consultants were appointed to conduct a Basic Assessment Report (BAR) in terms of NEMA for activities not included in the initial EIA(Eskom, 2016).

3.2.2 STEPS 2 AND 3: IDENTIFY LIKELY PROJECT IMPACTS AND PRIORITISE

In order to gain an understanding of the pre-construction baseline trends and conditions of each of the selected Eskom projects, the EIRs and specialist reports compiled by independent consultants were downloaded from the Eskom website (http://www.eskom.co.za/OurCompany/SustainableDevelopment/EnvironmentalImpactAssessments/Pages/EIA_Archive_Of_Completed_Projects.aspx). The entire final EIR as well as the associated specialist environmental reports for each project were read and analysed to get insight of the scope for each project. The EIR as well as the associated specialist reports and EMPs were analysed to identify all predicted environmental impacts for each project. All the potential impacts likely to occur during the construction phase only were shortlisted. The construction phase impacts were selected because all the selected Eskom projects are currently in the construction phase. Of the all shortlisted construction phase impacts, only the impacts which would have a direct or cumulative impact on the biophysical environment

were further shortlisted. The social and socio-economic impacts were excluded because they would be quite difficult to assess and would require extensive research and time. The biophysical construction phase impacts included (but were not limited to) disturbance to flora and fauna, impacts on water courses, windblown dust, soil erosion, noise pollution, litter/waste, utilisation and storage of hazardous substances, risks of fires, visual/aesthetics impacts etc.

The shortlisted environmental impacts as described in the EIRs and specialist reports for each project were captured in a spreadsheet. The shortlisted impacts differed per project, therefore the impacts were divided into four main categories, namely 1) hydrological impacts, 2) flora & fauna impacts, 3) visual/noise impacts, 4) air impacts, 5) waste impacts and lastly 6) other (which included all predicted impacts that did not fall into any of the five categories, for example veld fires and soil erosion). This was done to gain a better understanding of which impact categories are generally well predicted or overlooked and identify if there are any similarities or major differences in impact prediction between projects per impact category.

3.2.3 STEP 4: IDENTIFY PROTOCOLS FOR FIELD INVESTIGATIONS (INCLUDING INTERVIEW SCHEDULES)

Field investigations and site observations were not conducted due to limited access to sites and because my assessments would have been subjective and not objective. Therefore, the EA and Construction Environmental Management Plan (CEMP) compliance audit reports were used as they provided a more detailed, accurate and reliable assessment of the actual impacts per site. The audit reports were obtained from the Eskom Sustainability department responsible for all new build projects. To ensure objectivity, the audit reports compiled by accredited auditors/ environmental specialists contracted by Eskom formed the basis of the assessment and provided in depth information regarding the current site activities and management mechanisms employed. These audits are conducted bi-annually for Kusile and Medupi power station and quarterly for the Ingula Pumped Storage Scheme. The audits were conducted over a period of 2-3 days and were followed by the compilation of an audit report. The audit reports document the findings and recommend corrective/management actions to be considered. For the purpose of this study, the most recent (2015/2016) audit reports for each project submitted to Eskom were used to identify all the biophysical construction phase impacts that actually occurred on site. The audit reports were also used to identify any new impacts which may have been omitted in the EIRs and/or specialist reports.

The most recent aerial images of each project area were obtained from Google Earth and compared to the aerial images pre-construction to identify any large scale environmental damage caused by the development such as habitat destruction and fragmentation, wetland destruction, river re-alignment, etc. (Appendix A). In order to obtain small scale and detailed information regarding impact occurrence, each site's environmental officer, advisor and/or manager that was either involved with each project from the beginning stages, or had sufficient knowledge of the actual impacts was interviewed. Two environmental practitioners were interviewed at each site but a single questionnaire was completed with a combination of both their responses. Interviews in the form of a multiple choice questionnaire with a few open-ended questions were used (Appendix B). One interview template was used for all interviews conducted. The interviews focussed on the impacts that occurred during the construction phase of the project. The multiple choice questions addressed the combined predicted impacts of the three Eskom projects, however some project-specific impacts were omitted in order to keep the questionnaire concise. Any additional project-specific information was noted and further discussed during the interview. The interviews were only conducted once approval was given by the University's Human (non-medical) Ethics Screening Committee (Clearance number: H15/02/17).

3.2.4 STEP 5: COMPARE ACTUAL IMPACTS TO PREDICTED IMPACTS

In order to compare the actual impacts to the predicted impacts, the following information was captured in the spreadsheet (Appendix C): impact category (e.g. hydrological impacts), predicted/not predicted environmental impacts, impact description (detailed description on how the impact would cause or has caused damage to the environment), actual impact occurrence and comments. Under 'actual impact occurrence' one of three possible ratings were assigned:

- **Occurred and predicted** (OP)- Impacts which occurred causing a noticeable change in the environment compared to the baseline conditions on site (regardless of mitigation measures) and were predicted in the EIR and specialist reports;
- **Occurred but not predicted** (ONP)- impacts which occurred on site but were not predicted i.e. unexpected/unforeseen impacts; and
- **Predicted but did not occur** (NP) - impacts that had not yet occurred on site but were predicted in the EIR and specialist reports.

Additional information obtained from the interviews and compliance audit reports were noted under 'comments'.

3.2.5 STEP 6: DETERMINATION OF CAUSE OF ERROR & DATA ANALYSIS

The data collected was separated into two categories: 1) impacts which '*occurred*' and 2) impacts which were '*predicted*'. Of the impacts which actually occurred on site, each impact either occurred as predicted in the EIRs (OP) or occurred but was not predicted (ONP). The percentage of impacts which arose but were not predicted was identified as discrepancies in the EIRs, as they were omitted from the documents completely. These impacts were assessed to determine the possible reasons why they may have been overlooked.

The impacts which were predicted in the EIRs either occurred as predicted (OP) or did not occur as predicted (NP). The percentage of impacts which were predicted and actually occurred gave an indication of accuracy based on impact prediction. For the purpose of this study this percentage was used to compare the findings to other similar studies and rate the level of impact prediction accuracy of Eskom EIRs. The percentage of impacts which were predicted but did not actually occur was identified as discrepancies in the EIRs. All the possible reasons why these impacts may have been initially predicted but not occur were identified.

3.3 LIMITATIONS TO THE STUDY

Many challenges and limitations were encountered during the EIR assessment. These limitations included but are not limited to the following: the three EIRs were inconsistent with regards to the compilation and the information provided. This could be because the EIRs were conducted under the ECA regulations which did not provide set procedures on how to conduct an EIA or set standards for Environmental impact Assessment Practitioners (EAPs) competencies (RSA, 1989). EAPs play a vital role in communicating with the proponent, the regulatory authorities and the public; and their credibility is very important in ensuring that the quality of the EIR is of good standing (Rehman Shah, 2013). This can only be improved by ensuring that the EAPs are competent in EIA compilation. There were also limited interviewees; only two environmental practitioners were interviewed per site. Lastly, when analysing the compliance reports, it was not always clear if the findings noted were impacts which were predicted in the EIRs or not, therefore every impact had to be checked against the EIA and specialist reports.

CHAPTER FOUR: RESULTS

4.1 PREDICTED VERSUS ACTUAL IMPACTS

The data indicated that in total 44 impacts occurred. Of the 44 impacts, 40 (91%) impacts were predicted and occurred (OP) and 4 (9%) impacts were not predicted but occurred (ONP). Figure 4.1 illustrates the actual impact occurrence for all projects.

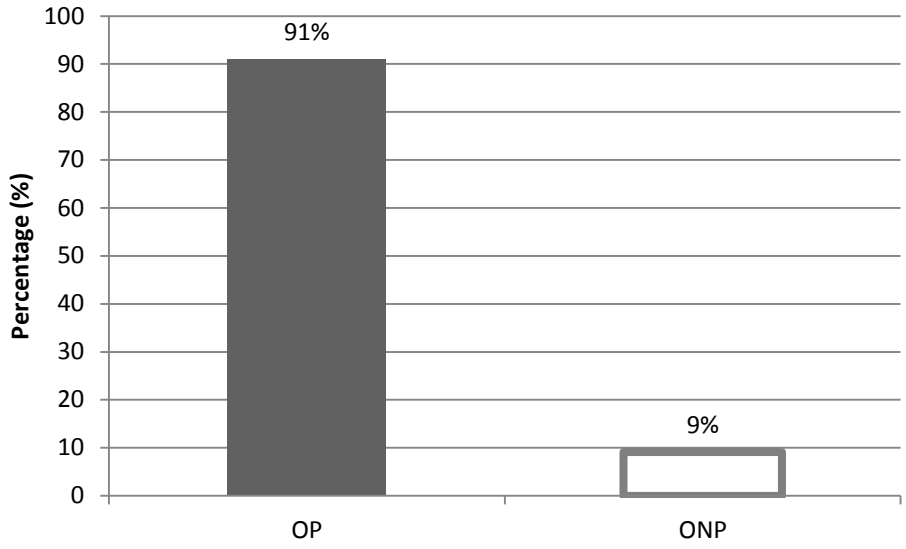


Figure 2.1 Percentage of actual impact occurrence for all projects

The data also indicated that in total 47 impacts were predicted in the EIRs. According to the data gathered from the audit reports and interviews, of the 47 impacts predicted, 40 (85%) occurred as predicted (OP) and 7 (15%) did not occur as predicted (NP). For the purpose of this study, these percentages were used to assess the accuracy of the impacts predicted in the EIRs. Figure 4.2 illustrates the impact prediction accuracy for all projects.

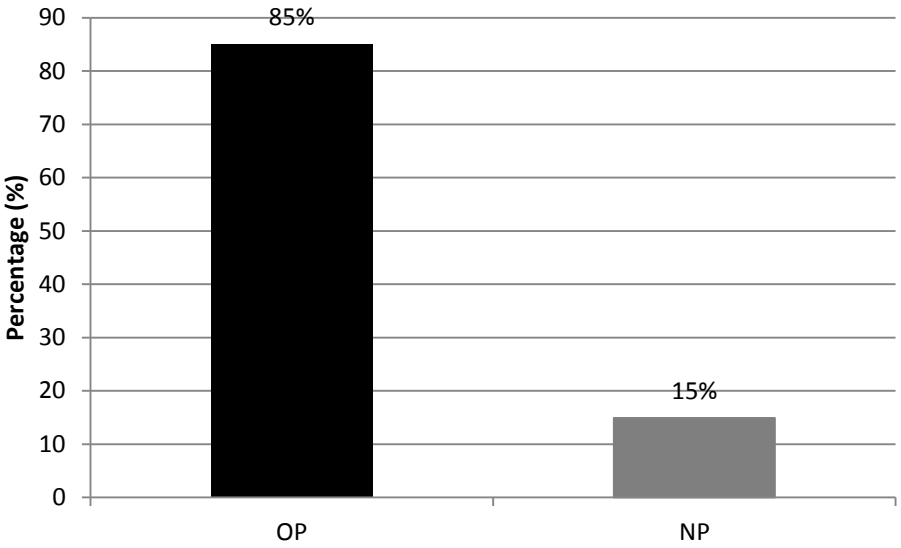


Figure 4.2: Percentage of impacts predicted for all projects

Figure 4.3 below shows the impact occurrence per impact category. Seventy-three percent (73%) of the hydrological impacts occurred as predicted and 27% occurred but were not predicted. A 100% of the flora and fauna impacts, visual and noise impacts, waste impacts and other impacts occurred as predicted in the documents. Seventy-five percent (75%) of the air quality impacts occurred as predicted and 25% occurred but were not predicted.

As shown in Figure 4.3, the majority of the impacts which occurred but were not predicted were hyrological impacts. Twenty-seven percent (27%) of the hydrological impacts and 25% of the air impacts occurred but were ommitted from the EIRs and specialist reports. Out of the 11 hydrological impacts which actually occurred in reality, 3 of the impacts were not predicted. These impacts included: 1) ponding of poor quality which may recharge groundwater; 2) spread of polluted surface water; and 3) silting of storm water drains. Out of 4 air impacts, only 1 occurred but was not predicted. This impact was air pollution due to fly ash spills and ash spillages around the site. All the other impact categories occurred as predicted in the EIR and specialist reports.

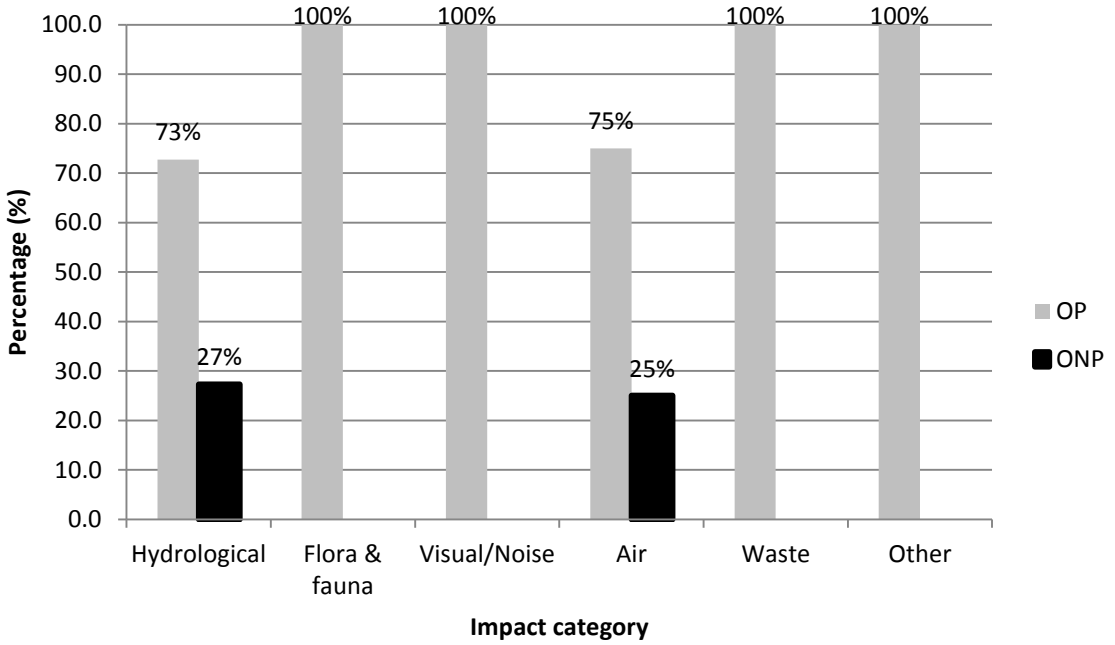


Figure 4.3: Percentage of actual impact occurrence per impact category

Figure 4.4 below shows that of all the impacts predicted, a 100% of the visual/noise impacts, air and waste impacts occurred as predicted. However 27% of the hydrological impacts, 7% of the flora and fauna impacts and 30% of the other impacts which include soil pollution, fires and loss of agricultural potential were predicted and did not occur on site.

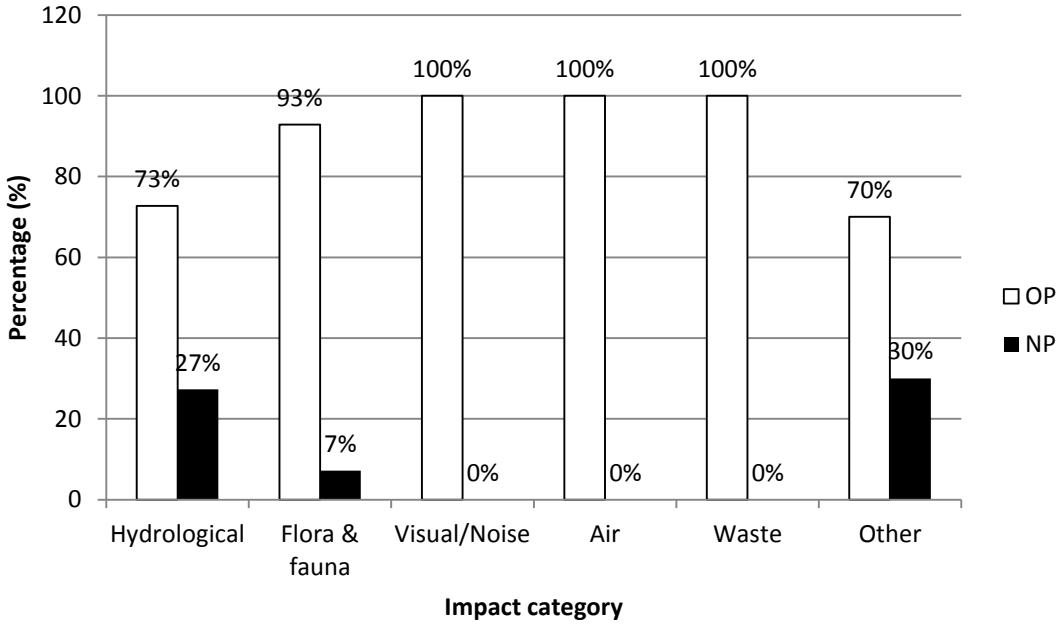


Figure 4.4: Percentage of impacts predicted per impact category

Table 4.1 provides a summary of all the impacts which were predicted in the EIRs and specialist reports but did not occur based on the audit reports, interviews and aerial photographs. These are impacts which were predicted in the EIR and specialist reports, but have not yet come to pass at the construction sites. This may be due to effective mitigation measures and management plans to prevent occurrence completely.

Table 4.1: Summary of the impacts which did not occur as predicted

Project	Impact category	Predicted impact	Description	Comments
Kusile PS	Hydrological	Impact on water resources by chemicals	Chemicals and material used on site during construction if spilled could end up in the rivers.	No incidences of hazardous spillages contaminating the watercourses were noted.
Medupi PS	Hydrological	Removal of surface water from catchment	The water used in the Flue gas desulphurisation (FGD) processes cannot be treated for discharged back into the river thus reducing the water levels in the catchments.	It was not noted whether the water level in the catchments have decreased or not. However, the FGD process has not yet began.
Medupi PS	Hydrological	Gypsum impact on groundwater	Gypsum manufacturing has the potential to impact negatively on the groundwater and surface water resources	Gypsum has not affected the groundwater at the site. Proper measures have been put in place to avoid ground water pollution.
Kusile PS	Flora and fauna impacts	Impact on vegetation	Removal of more vegetation cover than is required to establish the power station and its associated infrastructure, with the potential to impact on the identified protected plant species, with knock-on effects for the animals that utilise that habitat.	No unnecessary removal of vegetation was noted on site. Only vegetation in demarcated areas was removed.
Ingula PSS	Other	Soil pollution	Creosote poles may be used during the project and may have a negative health implications and an ecological impact	No negative implications of creosote have been recorded but it may occur in future over time.
Ingula PSS	Other	Fires	The construction of the line may alter the occurrence and management of fires in the area. The change in the nature of fire hazards and events can have safety, economic and ecological implications.	No recent fires have occurred on site.
Ingula PSS	Other	Loss of agricultural potential	Restrictions on land use and activities will impact on the agricultural potential of the land.	Significant impacts on agricultural potential were not noted.

4.2 INTERVIEWS

During the interviews it was clear that all environmental practitioners were aware of the EA conditions for each project, however it was noted that not all conditions were applicable. Kusile PS in particular had to apply for many amendments in order to comply with specific EA conditions, at Medupi PS certain conditions around erosion for the construction phase were too generic and at Ingula PSS it was noted that complying with the EA conditions was practical but costly. When asked if the projects were compliant with the EA conditions, all practitioners agreed and referred to the most recent audit report scores. Kusile PS received 98% compliance to EA conditions in July 2015, Medupi PS received 96.9% in November 2015 and Ingula PSS received 100% in June 2016. There is a high possibility that the EA compliance audit scores for Kusile and Medupi PS may have improved in the current year (2016), however the 2016 audit reports had not yet been submitted to Eskom. It was noted that the projects are highly compliant to the EA conditions because they are regularly audited (biannually or quarterly) and they are required to rectify previous findings and continually improve environmental performance at each site. The practitioners pointed out that the EA and EIR are equally important and projects need to comply with both documents as the EA emanates from the EIR. The practitioners stated that the EIRs and specialist reports are often checked after construction has begun to determine if certain impacts were predicted or not. Overall, all the practitioners agreed that the EIA is an effective tool in protecting the environment as it is used to guide development projects.

CHAPTER FIVE: DISCUSSION AND CONCLUSION

In this study I set out to assess the actual occurrence of impacts predicted in the three EIRs compiled for Eskom and to review the value of the EIA follow-up process as a management tool. In order to assess the effectiveness of the EIA and its influence on development projects, the EIA follow-up process was used to compare actual and predicted impacts. All possible explanations for discrepancies identified in the EIRs are described, the importance of EIA follow-up is discussed and recommendations for future studies are provided.

5.1 PREDICTED VERSUS ACTUAL IMPACTS

Much experience has been gained internationally on EIA development and the pre-decision phases. However, whether the project happens as anticipated after the approval has been granted is an area of concern (Arts *et al.,* 2001). Available literature has focused on the relevance and rationale of EIA follow-up (Dipper *et al*, 1998); the suggested methodologies for EIA follow-up (Arts, 1998; Wilson, 1998); the technical aspects of EIA prediction accuracy and quality (Culhane *et al.* 1987) and lastly the relationship between environmental management and EIA monitoring (Glasson, 1994). However, issues such as if the actual impacts on site are in accordance with the impacts predicted in the EIR have been addressed far less. EIA follow-up is therefore required in order to monitor the real effects of development projects on the environment and provide direction on how future EIAs should be developed.

If we only consider the impacts which actually occurred on site, the results showed that 91% of them were accurately predicted in the EIRs and 9% were omitted from the documentation. Similarly, if one considers what was stipulated in the reports versus what actually happened on site, the results showed that 85% of the actual impacts were in accordance with the initial predictions and 15% were not because they had not occurred as expected. This 85% accuracy of predictions exceeds previous national studies such as the study presented by Jordaan (2010), whereby 66% of the impacts were accurately predicted for the Mooi River Mall, with some of the impacts being unavoidable and a few unforeseen impacts occurring. The results also exceeded the 69.6% accuracy of predicted impacts for projects in the Free State and Northern Cape provinces (Freemantle, 2008). In the study most of the impacts were accurately predicted and the suggested mitigation measures were fairly successful at minimising or completely preventing the impacts from occurring. When compared to an international study presented by Wood *et al.* (2000) where 79% of the impacts were accurately predicted, it can be concluded that overall the Eskom projects did quite well.

This relatively high level of accuracy in impact prediction (85%) is encouraging and demonstrates that most of the actual impacts were expected and accordingly well planned for. This suggests that the EIA has a significant influence on development projects and is able of steering each project towards an environmentally-friendly path. The three Eskom projects are large scale development projects commissioned due to an increase in demand for electricity. Therefore, these projects are of great concern to the nation, thus they are constantly under pressure from the public, government as well as other NGOs to maintain an above average environmental performance. For such large projects the public plays an active role in identifying potential impacts and their input is meaningful, making the EIA effective in addressing their concerns as well. Because the projects are high-profile and highly visible, there is also increased surveillance from authorities such as the DEA to ensure compliance. Hence the sites are visited regularly post-decision making and compliance audits are regularly conducted. According to the interviews, in instances where the projects are not compliant (e.g. require permits/licences) or do not meet the environmental standards or requirements, the projects are halted. This is done to ensure that the projects to not continue because of the harmful effects they may have on the environment.

Eskom projects are large scale developments; they occupy large areas and have the potential to cause significant environmental damage if not managed effectively. However, because they are initiated by the government and are high priority projects, they are often well budgeted for (Freemantle, 2008). Government has now strengthened their focus on environmental compliance and auditing, making sure that efficient EIA follow-up is conducted in the form of regular site visits, monitoring and systematic compliance auditing (Ndlovu, 2015). The interviewees indicated that the EAs are also constantly amended in order to ensure that the projects are compliant to the most recent regulations (e.g. NEMA 2014 EIA regulations). This is done to ensure that the projects are of good standing environmentally and adhere to the current regulations of the country. There are also no major resources or capacity constraints with regards to minimising the effect of the project on the environment, which enables projects to be carried out in an environmentally sound manner.

This high percentage of accuracy may also be attributed to the fact that the majority of the impacts predicted are commonly anticipated during the site establishment and construction phases of a large scale development (Freemantle, 2008). The Eskom projects are from a long-standing industry (Morrison-Saunders *et al.,* 2001); therefore the impacts likely to occur during the developments could be drawn from previous studies conducted for similar projects and information gathered from their audit findings. On the other hand, Buckley (1991) suggests that the accuracy of most predicted impacts could be because the impacts were all described in a vague manner

(Freemantle, 2008). Often the predicted impacts are described in a qualitative descriptive manner and only give an indication of whether a negative impact might occur, if it will be significant and what mitigation measures can be used (Freemantle, 2008). Impact predictions could be vaguely described because most impact reports (scoping reports and EIRs) are written in a way to clarify and simplify possible predictions. This is done so that the document can be understood by interested and affected parties and the general public (Freemantle, 2008). However, if the specialist reports and EMPs are used in conjunction with the EIRs, the predicted impacts become more precise.

Discrepancies identified in EIRs

Nine percent (9%) of the impacts for the three projects combined occurred on site but where not predicted in the EIRs and/or specialist reports. These impacts were identified during the interviews and after a thorough assessment of the audit reports. Inaccuracies in EIA impact identification and predictions are common because environmental consultants are required to assess variables that are difficult to predict, so they often use other similar development projects as a reference (Lawrence, 2007). According to the impact categories, 27% of the hydrological impacts and 25% of the air quality impacts occurred but were not predicted. These unexpected impacts were most probably overlooked because they are site-specific and temporary in nature and are would not cause any significant environmental damage. Most unexpected impacts were also seasonal impacts which can be easily managed and mitigated on site, e.g. ponding of sites will only occur during the rainy seasons.

Fifteen percent (15%) of the predicted impacts in the EIRs had not yet occurred on site (Refer to table 4.1.), but they may still occur in future. These impacts were most likely predicted based on the impacts that had occurred at similar large scale developments. The reason for some impacts being predicted and not occurring in reality could be a result of the 'risk averse' approach followed in the EIA process (Jordaan, 2010). This approach identifies a large number of impacts which could possibly occur and often some do not occur in reality (Jordaan, 2010). This kind of approach results in a lower risk of omitting impacts and provides opportunities for impacts not predicted in the EIRs to be managed and mitigated accordingly (Jordaan,2010). It is not surprising that some of the predicted impacts do not occur in reality; however the low percentage (15%) of non-occurring impacts confirms that the bulk of the predicted impacts were well predicted. The predicted impacts may have also not occurred at all because of effective management controls put in place to prevent any incidences.

According to Tomlinson and Atkinson (1987), in the past the EIA process was simply seen as a paperwork exercise that needed to be done because it was legislated. But nowadays the EIA process is generally seen as a user-friendly and valuable process conducted before the commencement of any project to minimise environmental harm. Tomlinson & Atkinson (1987) also stated that many environmental practitioners believed that most of the attention was paid to the process leading up to the authorisation and little attention was given to what happened after the authorisation was granted. This belief has now changed as these days sufficient attention is given to what happens after the EA is granted through the implementation of EIA follow-up (Ndlovu, 2015).

Value of EIA follow-up

International case studies identified by Morrison-Saunders *et al.* (2001) indicate that the EIA follow-up process should ensure that a project and its activities are sustainable (Jordaan, 2010). It is therefore wise to conduct EIA follow-up to ensure that the developments are economically, socially and environmentally viable even without a legislative mandate to do so. EIA follow-up provides the opportunity to improve individual project management controls by providing concrete evidence of the environmental outcomes and incorporating the findings into the management plans. By knowing and understanding the real impacts after the project has been implemented, EIA follow-up can improve future EIA practices (Jordaan, 2010). A Canadian case presented by Noble and Storey (2005) stated that follow-up is very important and can improve the quality of EMPs and EA issued. The EIR is a vital requirement for any development project because it is the 'foundation' of a project and everything builds from it.

This study found that the EIRs prepared for the three Eskom projects were very accurate with regards to impact prediction. This information could be used to improve the quality of EMPs and EAs by focussing on the impacts which occurred but were not predicted, and providing detailed mitigation measures and management controls for such impacts. The measures put in place for the impacts which were predicted but have not yet occurred on site could be enhanced to completely avoid the impacts from occurring in future. This information could also be used in future studies by ensuring that practitioners take site specific, seasonal and minor impacts into consideration when compiling the EIRs to avoid the occurrence of impacts which have not been predicted. Practitioners should also refrain from only referring to similar sites to deduce impact predictions but pay more attention to the details.

The purpose of EIA follow-up is to understand the EIA outcomes, provide opportunities to learn from past experiences and apply this knowledge to future EIAs (Jordaan, 2010). Without EIA follow-up feedback, the EIA process remains static and affects the overall EIA practice efficacy (Dipper, 1998). The chances of duplicating information in the EIAs and conducting irrelevant analyses and investigations become high without such feedback (Dipper, 1998). EIA follow-up is able to identify the impact types and categories that tend to be more or less accurately predicted in each project, thus clarifying the sorts of impacts that specific development types commonly give rise to (Dipper, 1998). Knowing such information could help improve methods and techniques used in the EIA impact prediction process (Tomlinson & Atkinson, 1987). Post-decision EIA follow-up is vital for dealing with uncertainty and may in future lead to advances in prediction accuracy (Dipper, 1998). The process can also provide baseline information for future EIAs and improve the impact significance determination practice (Dipper, 1998). Lastly, EIA follow-up can enhance public awareness by providing information on the actual impacts a development may have on the environment and involving the public into future EIA processes.

5.2 RECOMMENDATIONS

Recommendations for future studies include:

- *evaluating projects of different scales (minor and major)* to identify if the high accuracy is only common in large scale projects or the same across the board;
- *evaluating different type of projects* to determine if the high impact prediction accuracy is only applicable to Eskom/government projects, and to assess the accuracy of projects initiated by the private sector;
- *including social and cultural impacts* to assess how accurately social and cultural impacts are predicted in the EIRs;
- *incorporating the operational phase impacts* to determine if the high impact accuracy is only applicable to construction phase impacts or not;
- *interviewing more environmental practitioners per site* to get more insight on the perspectives of EAPs on the EIA and EIA follow-up processes;
- *Interview external environmental specialists and/or auditors* as they may have different views and perspectives on the influence that the EIA process has on development projects;
- *avoid using a generic questionnaire template* in order to get better insight on the site specific impacts.

Recommendations for EAPs or EIA follow-up practice in general:

- equal attention needs to be placed on pre- and post-decision processes;
- all EIA follow-up participants should be provided with necessary environmental education and awareness;
- provisions for sufficient resources and capacity for follow-up activities should be made for all development projects;
- regulators need to ensure that follow-up is taking place for all projects;
- a more detailed description of the follow-up activities should form part of the EA;
- a standard audit model to audit predicted impact accuracy should be developed.

5.3 CONCLUDING REMARKS

Decision makers are often interested in the reliability and accuracy of information in the EIAs. Therefore it is important to follow up on impacts predicted in order to assess the level of accuracy of the EIAs published in South Africa. Knowing the level of accuracy of the reports will help improve the preparation of future EIA and EMP reports, thus improving the reliability of the information published. EIA follow-up not only fills the gaps of knowledge but also helps improve overall environment management. However, follow-up needs to be enhanced at all levels to ensure that practitioners are able to learn from experience and integrate all findings into future report compilations. Overall it can be concluded that the impact prediction accuracy of the three EIRs compiled for Eskom exceed previous studies conducted nationally. According to this study, Eskom EIRs are highly accurate with minor discrepancies which can easily be rectified. Most impact prediction inaccuracies were minor and temporary in nature. Majority of the impacts omitted were hydrological impacts which may have been caused by factors out of our control e.g. seasonal changes and/or changes in weather patterns. Also most of the impacts predicted which have not occurred were general impacts common to all developments and not site specific. This information may be used to improve future EIAs for similar projects by highlighting some of the impacts to be aware of when conducting baseline assessments and compiling the reports.

Now that EIA follow-up has been incorporated into the NEMA 2014 EIA regulations, the process is now mandatory and will contribute towards improving the utility of the EIA. It is only a matter of time until the EIA follow-up process becomes an effective tool in ensuring sustainable development. The selected Eskom projects encountered many challenges but also reached numerous milestones, while keeping the impacts on the environment to a minimum (where

possible) during the construction phase. The EIA is therefore an effective tool in protecting the environment.

REFERENCES

ACHIENG OLGA, P.F. (2009). *Environmental Impact Assessments general procedures*. http://www.os.is/gogn/unu-gtp-sc/UNU-GTP-SC-10-0801.pdf [Accessed 03/03/2017]

AHAMMED, A. AND NIXON, B.M. (2006). Environmental Impact Monitoring in the EIA Process of South Australia. *Environmental Impact Assessment Review*, vol. 26, pp. 426-447.

ALERS, A. (2016). *A review package for South African EIA follow-up performance*. Dissertation submitted in fulfilment of the requirements for the degree Magister Scientiae in Geography and Environmental Management at the Potchefstroom Campus of the North-West University. (Unpublished Master's thesis)

AURECON. (2015). *The role that EIAs are presently playing and can potentially play in promoting Sustainability in South Africa*. http://aurecongroup.com/en/thinking/archive/the-role-of-eia-in-achieving-sd.aspx. [Accessed 27/01/2016].

ARTS, J. (1998). *EIA Follow-up – On the Role of Ex Post Evaluation in Environmental Impact Assessment.* Geo Press, Groningen.

ARTS, J. AND MEIJER, J. (2004). Designing for EIA follow-up: experiences from the Netherlands, in a Morrison-Saunders and J Arts (editors), *Assessing Impact: Handbook of EIA and SEA Follow-up*. Earthscan, London, pp. 63-96.

BABIKER, M. REILLY,J.M. AND JACOBY.H.D. (2000). The Kyoto Protocol and developing countries. *Energy policy.* Vol.28, no.8, pp. 525–536.

BARTLET R.V. (1988). Policy and Impact Assessment: An introduction, *Impact Assessment Bulletin* Vol.6, no.2, pp.73-74.

BUCKLEY, R.C. (1991). How accurate are environmental impact predictions. *Ambio Stockholm*, vol.20, no.3-4, pp.161-162.

CASHMORE, M., GWILLIAM, R., MORGAN , R., COBB, D., BOND, A. (2004). The interminable issue of effectiveness substantive purposes, outcomes and research challenges in the advancement of environmental impact assessment theory. *Impact assessment and Projects Appraisal,* vol.22, no.4, pp.295-310.

CELE, S.C. (2016). *Exploring post-authorisation follow-up and EIA effectiveness in South Africa: case studies from KwaZulu-Natal*. Submitted in fulfilment of the academic requirements for the: Master of Social Science Degree, in the discipline of Geography and Environmental Management, School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal. (Unpublished Master's thesis)

CULHANE, P.J. (1987). The precision and accuracy of U.S environmental impact statements, *Environmental Monitoring and Assessment,* vol.8, no.3, pp 217-238.

CULHANE, P.J. (1993), Post-EIS environmental auditing: a first step to making rational Environmental Assessment a reality, *Environmental Professional,* Vol.15, pp. 66-75.

DANTES, (2016). *Environmental Risk Assessment*. www.Dantes.info/Tools & Methods/Environmentalassessment/enviro_asse_era.htm. [Accessed 03/02/2016]

DEPARTMENT OF ENERGY. (2009). *Digest of South African energy statistics 2009.* www.energy.gov.za/files/media/explained/2009%20Digest%20PDF%20version.pdf. [Accessed 12/06/2014]

DEPARTMENT OF ENERGY. (2010). *South African energy synopsis 2010*. www.energy.gov.za/files/media/explained/ 2010/South_African_Energy_Synopsis_2010.pdf [Accessed 08/06/2014]

DEPARTMENT OF ENVIRONMENTAL AFFAIRS. (2013). *Efficacy of SA's Environmental Impact Assessment (EIA) Regime.* http://db3sqepoi5n3s.cloudfront.net/B3A5A191-D89C-478E-8E6D-4D48D9496E68/FinalDownload/DownloadId-B964BB29D9BC5F77AD1FB8B50F9EDB28/B3A5A191-D89C-478E-8E6D-4D48D9496E68/files/130730dea.pdf [Accessed on the 26/11/2014].

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM (2008). Review of the Effectiveness and Efficiency of the Environmental Impact Assessment (EIA) system in South Africa', Draft Report, Department of Environmental Affairs and Tourism, Pretoria, pp 120.

DIPPER, B., JONES, C., AND WOOD, C. (1998). Monitoring and post auditing in environmental impact assessment: A review. *Journal of Environmental Planning and* Management, vol.41, no.6, pp.731-747.

DUTHIE, A.G. (2001). A review of provincial environmental impact assessment administrative capacity in South Africa. *Impact Assessment and Project Appraisal*, vol.19.no.3, pp 215-222.

EPA. (2016). *Environmental Management Systems (EMS).* www.epa.gov/ems [Accessed 03/02/2016]

ESKOM. (1999). *Environmental Impact Report for the proposed Braamhoek Pumped storage scheme.* http://www.eskom.co.za/OurCompany/SustainableDevelopment/EnvironmentalImpactAssessments/Documents/final_eir.pdf [Accessed 05/10/2014]

ESKOM. (2006). *Environmental Impact Report for the proposed establishment of a New Coal-Fired Power Station in the Lephalale Area, Limpopo Province.* http://www.eskom.co.za/OurCompany/SustainableDevelopment/EnvironmentalImpactAssessments/Pages/Medupi_Final_Impact_Assessment_Report.aspx. [Accessed 08/06/2014]

ESKOM. (2007). *Environmental Impact Assessment Process: Proposed Coal-Fired Power Station and associated Infrastructure in the Witbank Area.* http://www.eskom.co.za/OurCompany/SustainableDevelopment/EnvironmentalImpactAssessments/Documents/final_eir.pdf. [Accessed 08/06/2014]

ESKOM. (2011). *Eskom factor environmental.*

http://www.eskomfactor.co.za/eskom-factor-environmental.php. [Accessed 06/06/2014]

ESKOM. (2013). *Background Information Document* http://www.eskom.co.za/Final%20BID.pdf [Accessed 07/04/2015]

ESKOM. (2016). *What we are doing.* http://www.eskom.co.za/Whatweredoing/NewBuild/IngulaPumpedStorage/Pages/Ingula_Pumped_Storage_Scheme.aspx [Accessed 29/11/2016]

FREEMANTLE,S,J. (2008). *A comparative study of the quality and outcomes of Environmental Impact Assessment reports from the Free State and Northern Cape provinces.* University of the Free state. (Unpublished Master's thesis)

GEORGEADES, D. (2012). *Environmental Impact Assessment Follow-up in selected Cape Town case studies as an indicator of effectiveness.* Dissertation in fulfilment of Master of Science degree Department of Environmental and Geographical Science, Faculty of Science, University of Cape Town. (Unpublished Master's thesis)

GIDDINGS, B., HOPWOOD,B. AND O'BRIEN,G. (2012). Environment and Society: Fitting them together into sustainable development. *Sustainable Development, Vol.10, Issue 4***.**

GLASSON,J. (1994). Life after the decision: the importance of monitoring in EIA. *Built Environment*, Vol.20, no.4, pp.309–320.

GREENPEACE. (2012).*The Eskom factor: Power politics and the electricity sector in South Africa*.http://www.greenpeace.org/africa/global/africa/publications/coal/theeskomfactor.pdf [Accessed 06/06/2014]

GLAZEWSKI, J. (2005). *Environmental Law in South Africa, Durban*: LexisNexis Butterworths, pp.253.

GWIMBI, P. AND NHAMO,G. (2016). Effectiveness of Environmental Impact Assessment follow-up as a tool for environmental management: lessons and insights from platinum mines along the Great Dyke of Zimbabwe. *Environmental Earth Sciences* vol.*75, no.561.*

HARMER.C. (2005). *Is Improving the Effectiveness of Environmental Impact Assessment in the UK Dependent on the Use of Follow-up?* Views of Environmental Consultants. Thesis is presented in part-fulfilment of the degree of Master of Science in accordance with the regulations of the University of East Anglia. (Unpublished Master's thesis)

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. *Intergovernmental Panel on Climate Change*, vol.1.

JALAVA, K. (2014) Quality of Environmental Impact Assessment in Finland. *Jyväskylä Studies in Biological and Environmental Science* vol.289.

JAY, S., JONES, C., SLINN, P. AND WOOT, C. (2007). Environmental impact assessment: Retrospect and prospect. *Environmental Impact Assessment Review.* Vol.27, Issue.4, pp.287-300.

JORDAAN, I. (2010). *Environmental Impact Assessment follow-up in South Africa: Critical analysis of predictions and compliance for the Mooi River Mall case study.* Mini-Dissertation submitted in partial fulfilment of the requirements for the Degree Master of Environmental Management, North-West University (Potchefstroom Campus). (Unpublished Master's thesis)

KRUGER, E. AND CHAPMAN, O.A. (2005). Quality Aspects of Environmental impact assessment reports in the Free State Province, south Africa. *South African Geographical Journal,* Vol.87, issue 1.

LAWRENCE, D.P. (2007). Impact significance determination- Back to basics. *Environmental Impact Assessment Review* vol.27, pp.755–769.

LOCHNER, P. (2005). *Guideline for Environmental Management Plans*. CSIR Report No ENV-S-C 2005-053 H. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

MARSHALL, R. (2005) Environmental Impact assessment follow-up and it's benefit for industry. *Impact Assessment and Project Appraisal,* vol.23, no.3.

MARSHALL, R., J. ARTS AND MORRISON-SAUNDERS, A. (2005). International Principles for Best Practice EIA follow-up. *Impact Assessment and Project Appraisal*, vol.23, no.3, pp.175-181.

MORRISON-SAUNDERS, A., ARTS.J, BAKER.J AND P. CALDWELL. (2001). Roles and Stakes in Environmental Impact Assessment Follow-up, *Impact Assessment and Project Appraisal*, vol.19, pp.289–296.

MORRISON-SAUNDERS, A., BAKER.J AND ARTS, J. (2003). Lessons from Practice: Towards Successful Follow-Up, *Impact Assessment and Project Appraisal*, vol.21, pp.43–56.

MORRISON-SAUNDERS, A. AND ARTS, J. (2004). *Assessing Impact: Handbook of EIA and SEA Follow-up*, Earthscan James & James, London.

MORRISON-SAUNDERS, A. AND FISCHER, T.B. (2006). What is wrong with EIA and SEA anyway? A sceptic's perspective on sustainability. *Journal of Environmental Assessment Policy and Management*, vol.8,no.1, pp.19-39.

MORRISON-SAUNDERS, A. (2007). *Effective impact assessment follow-up, Training manual,* presented at IAIA'07, 27th conference of International Association for Impact Assessment, School of Environmental Science, Murdoch University, Western Australia.

MORRISON-SAUNDERS,A., MARSHALL, R., ARTS, J. (2007). *EIA Follow-Up International Best Practice Principles.* National Environmental Management Act 107 of 1998.

MYERS,N. AND KENT, J. (2005), *The New GAIA Atlas of Planet Management,* Gaia Books.

NDLOVU, N.M. (2015). A critical assessment of EIA follow-up conditions formulated for Environmental Authorisations in Mpumalanga Province Mini-dissertation submitted in partial fulfilment of the requirements for the degree *Magister* in *Environmental Management* at the Potchefstroom Campus of the North-West University. (Unpublished Master's thesis)

NIJSTEN, R. and ARTS, J. (2004). *Going Dutch: a quick scan approach to EIA-follow up.* Paper presented at the 24th annual meeting of the International Association for Impact Assessment, 24-30 April 2004, Vancouver, Canada.

NOBLE, B. AND MACHARIA, S.N. (2004). *Towards a working framework for 'best'-practice EA follow-up: lessons from Canadian case studies*. *http://pcag.uwinnipeg.ca/Prairie-Perspectives/PP-Vol07/Noble-Macharia.pdf* [Accessed 12/10/2016]

NOBLE, B. AND STOREY, K. (2005). Towards increasing the utility of follow-up in Canadian EIA. *Environmental Impact Assessment Review*, vol.25, pp.163-180.

POLONEN, I., HOKKANEN, P. AND JALAVA, K. (2011). The effectiveness of the Finnish EIA system-what works, what doesn't and what can be improved, *Environmental Impact Assessment Review*, vol.31, pp.120-128.

RAMJEAWONA.T.BEEDASSY.R (2004) Evaluation of the EIA system on the Island of Mauritius and development of an environmental monitoring plan framework- A Review. *Environment Impact Assessment* , vol.24, pp.537- 549.

REHMAN SHAH,N. (2013). *Role of EIA practitioners in improving EIA reporting quality-challenges and solutions: A case study of EIA system in Punjab Pakistan.* (http://www.iaia.org/conferences/iaia13/proceedings/Final%20papers%20review%20process%2013/ROLE%20OF%20EIA%20PRACTITIONERS%20IN%20IMPROVING%20EIA%20REPORTING%20QUALITY%20-%20CHALLENGES%20AND%20SOLUTIONS.pdf?AspxAutoDetectCookieSupport=1) [Accessed 17/06/2015]

REPUBLIC OF SOUTH AFRICA. (1989). Environment Conservation Act, 1989 (Act 73 of 1989), Pretoria: Government Printer, pp 35.

REPUBLIC OF SOUTH AFRICA. (1996). Constitution of the Republic of South Africa Act 108 of 1996, Pretoria: Government Printer, pp 107.

REPUBLIC OF SOUTH AFRICA. (1997a). Regulation 1182 in terms of Section 21 of Environmental Conservation Act, Act 73 of 1989', Department of Environmental Affairs and Tourism, Pretoria, Government Gazette 18261, pp 5.

REPUBLIC OF SOUTH AFRICA. (1997b). Regulation 1183 in terms of Section 26 and 28 of Environmental Conservation Act, Act 73 of 1989', Department of Environmental Affairs and Tourism, Pretoria, Government Gazette 18261, pp19.

REPUBLIC OF SOUTH AFRICA. (1997c). Regulation 1184 in terms of Section 26 and 28 of Environmental Conservation Act, Act 73 of 1989', Department of Environmental Affairs and Tourism, Pretoria, Government Gazette 18261, pp 1.

REPUBLIC OF SOUTH AFRICA. (2006). Regulations in terms of chapter 5 of the National Environmental Management Act, 1998', Department of Environmental Affairs and Tourism, Government Notice No. R. 385, 21 April 2006, pp 1-129.

REPUBLIC OF SOUTH AFRICA. (2010). Department of Energy. *South African Energy Synopsis* 2010. p.52 and p.66.

REPUBLIC OF SOUTH AFRICA. (2014). National Environmental Management Act,1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations 2014. *Government Notice 38282.*

ROSSOUW, N., AUDOUIN,M., LOCHNER.P., HEATHER-CLARK, S., WISEMAN,K. (2000). Development of strategic environmental assessment in South Africa. *Impact Assessment and Project Appraisal,* vol. 18, no.3, pp. 217–223.

SADLER, B. (1998). *Environmental assessment in a changing world: evaluating practice to improve Performance.* IAIA and Canadian Environmental Assessment Agency, Ministry of Supply and Services, Ottawa, Canada.

SAMPSON, I. AND VISSER, W. (2004), "Introduction", in I Sampson (editor), *The guide to environmental auditing in South Africa.* Butterworths, Durban.

SANDHAM,L.A. AND PRETORIUS,H.M. (2008). A review of EIA report quality in the North West province of South Africa. *Environmental Impact Assessment Review. Vol.28,Issues 4-5*,pp. 229-240.

SENÉCAL, P., SADLER, B., GOLDSMITH, B., BROWN, K. and CONOVER, S. (1999). P*rinciples of environmental impact assessment, best practice*. International Association for Impact Assessment, Fargo, ND. p.2.

SLINGER, J, P HUIZINGA, S TALJAARD, L VAN NIEKERK AND B ENSERINK (2005). From impact assessment to effective management plans: learning from the Great Brak Estuary in South Africa. *Impact Assessment and project Appraisal,* vol.23, no.3, pp.197-204.

TENNOY, A., KVAERNER, J. and GJERSTAD, K.I. (2006), Uncertainty in environmental impact assessment predictions: the need for better communication and more transparency. *Impact Assessment and Project Appraisal*, vol.24, no.1,pp. 45-56.

TOMLINSON, P and ATKINSON, S.F. (1987). Environmental audits: a literature review, *Environmental Monitoring and Assessment*, vol.8, pp. 239-261.

UNITED NATIONS ENVIRONMENT PROGRAM (UNEP). (2002). Environmental impact assessment training resource manual. Second ed. Australian EIA Network; 2002. URL, http://www.unep.ch/etu/publications/EIAMan_2edition_toc.htm. [Accessed 04/06/2015]

UNITED NATIONS UNIVERSITY. (2006). *Environmental Impact Assessment course module.*

http://sustainability-research.mcgill.ca/documents/EIA%20readings/eia-local/page123.htm [Accessed 04/05/2015]

WEAVER, A (2003). EIA and sustainable development: key concepts and tools, in Southern African Institute for Environmental Assessment (editor), *Environmental impact assessments.*

WILSON, L. (1998). A practical method for environmental impact assesment audits. *Environ Impact Assess*, vol.18, pp.59–71.

WOOD, C. (1999). Pastiche or Postiche? Environmental Impact Assessment in South Africa. *South African Geographical Journal*, vol.81, no.1, pp.52-59.

WOOD, C., DIPPER, B. AND JONES, C. (2000). Auditing the assessment of the environmental impacts of planning projects. *Journal of Environmental Planning and Management*, vol.43, no.1, pp. 23-47.

WORLD COMMISION ON ENVIRONMENT AND DEVELOPMENT (WCED). (1987). *Our common future.* Oxford: Oxford University Press, 1987 p. 43

YOUTHED, J.G. (2009). *Assessing and managing the potential for compliance default of applications submitted in terms of South Africa' environmental impact assessment regulations*. http://uir.unisa.ac.za/74082796-5149-4D76-95AA 846B23C3F087/FinalDownload/DownloadId- 952D2871C95FB65360C62951A6494A47/74082796-5149-4D76-95AA- 846B23C3F087/bitstream/handle/10500/2869/thesis_youthed_%20j.pdf?sequence=1 [Accessed 17/06/2014]. (Unpublished thesis)

APPENDIX A: AERIAL PHOTOGRAPHS



Figure A1: Aerial photographs of Kusile PS in 2004 and 2016 (https://www.google.com/earth)



Figure A2: Aerial photographs of Medupi PS in 2005 and in 2016 (https://www.google.com/earth)



Figure A3: Aerial photographs of Ingula PSS in 2008 and 2016 (https://www.google.com/earth)

APPENDIX B: QUESTIONAIRES

EFFECTIVE IMPACT PREDICTION IN ENVIRONMENTAL IMPACT ASSESSMENT REPORTS:

How accurate are predicted impacts after construction?

PURPOSE: To gain understanding from Environmental Officers (EO's) on the actual environmental impacts that have occurred during the construction and operation phases of Eskom generation projects, and to determine if the Environmental Impact Assessment (EIA) is an effective tool in protecting the environment and preventing adverse impacts on the environment.

INTERVIEWEE'S PARTICULARS

Power Station Name: _____ Position at company: Department: _____

QUESTIONS:

1. Was the damage/removal of vegetation inside and around the construction site significant during construction?
    a. Yes, more vegetation was removed than expected as the construction area was not clearly defined.
    b. Partially, most vegetation removed was in the defined areas.
    c. No, as the construction areas were clearly defined.

2. Have you seen any wildlife such as mongoose, jackals etc. in the vicinity of the site?
    a. Yes, we have seen wildlife.
    b. No, we have not seen any wildlife.

3. Have any protected trees been cut without a permit, or have any endangered animal species been killed during the construction and operation stages?
    a. Yes; _____(provide number and species)
    b. No protected trees or endangered animals have been affected.

4. Were the levels of soil erosion and stream/river sedimentation significant during construction?
    a. Yes, the levels of soil erosion and stream/river sedimentation were significantly high.
    b. No, the construction site erosion plan was effective in minimising soil erosion on site, thus lowering the rate of sedimentation.
    c. I do not know.

5. Have there been any reports of liquid effluent discharge, oil leakages or spills during the year (2014-2015).
    a. Yes, more than 5 reports.
    b. Partially, only 1-4 reports.
    c. No- no cases have been reported.

    If yes or partially, what mechanisms have been put in place to avoid future effluent discharge and leakages? What was the cause of the leak/spill?_____

    _____

    _____

6. During the construction and operation phases were wetlands affected, damaged or destroyed?
    a. Yes
    b. Partially
    c. No

    If yes or partially, what mitigation measures have been implemented to restore wetland functioning?_____

    _____

    _____

7. Has there been a significant increase in air pollution during the construction or operation phases (gaseous and particulate)?
    a. Yes, emissions significantly increased during both the construction and operation phases.
    b. Partially, there has been a slight increase in emissions only during the construction phase.
    c. No significant increase in emissions.
    d. I do not know

8. Has there been a significant impact on surface and ground water quality at the site or surrounding area?
    a. Yes, water quality and quantity has decreased significantly in and around the site.
    b. Partially, water quality and quantity has decreased slightly in the site.
    c. No, there is no significant impact on water quality and quantity.
    d. I do not know.

9. Are you aware of the environmental authorisation (EA) conditions for the project? If yes, do you believe that they are practical and relevant to the project?_____

    _____

    _____

10. Are you compliant to the EA condition, have there been any findings or non-compliance reports issued for this project? If yes, how many and have they been closed out?_____

11. Have you relooked at the Environmental Impact assessment (EIA) predictions and significance ratings after receiving the EA? If No, Why not?

12. Are EA conditions considered more important than the EIA predictions because they are enforceable and audits are conducted by the Department of a regular basis?

13. In your opinion is the EIA effective in protecting the environment? Do you follow up on the predicted impacts or consider them during the construction, operation stages?

14. Where there any unforeseen impacts that occurred that may have been excluded from the EIA predictions?

15. Please provide recommendations on how the EIA can be more user-friendly and practical in your opinion.

Additional Points

APPENDIX C: ACTUAL IMPACT OCCURRENCE

Table C1: Kusile PS actual occurrence ratings with comments from the site observations and interviews.

Kusile Power station				
Impact category	**Predicted/ not predicted environmental impact**	**description**	**Actual occurrence**	**Comments**
Hydrological impacts	Impact on water resources	Removal of vegetation covering will result in soil erosion causing an increase in the sediment load of rivers. Sediment load and pollution could have a negative impact on the fish and invertebrates in the rivers.	OP	Erosion control/ and Slope stabilisation measures were in areas associated with high risks to prevent silts from entering the canal which is now a watercourse.
	Impact on wetlands	Impact on wetlands due to erosion, sedimentation and/or pollution.	OP	The construction activities within Kusile have caused a loss of wetland habitat and ecosystem services.
	Impact on water resources by chemicals	Chemicals and material used on site during construction if spilled could end up in the rivers.	NP	No incidences of hazardous spillages contaminating the watercourses were noted.
	Poor surface water quality on site	Rainfall will form "dirty" water runoff within the site forming poor water quality. Ponding of poor quality may recharge groundwater.	OP	All water will be recycled, treated and reused. Ground water monitoring is currently being undertaken on a monthly basis.

Flora and fauna impacts	Impact on vegetation	Removal of more vegetation cover than is required to establish the power station and its associated infrastructure, with the potential to impact on the identified protected plant species, with knock-on effects for the animals that utilise that habitat.	NP	No unnecessary removal of vegetation was noted on site.
	Impact on flora and fauna	Impact on protected plant and animal species and red data species.	OP	Protected species were removed from site and relocated.
	Habitat degradation/ destruction	Impact on flora and fauna found in the wetlands.	OP	Wetland habitat and ecosystem services have been lost due to the PS construction.
Visual & noise impacts	Disturbance to sense of place and visual aesthetics	The visibility or visual exposure of any structure or activity within the region	OP	The buildings at Kusile are of temporary nature and no offensive /reflective colours implying significant visual impacts were identified.
	Noise pollution	significant increase in noise from the construction activities	OP	Records show that there has been an increase in noise levels at the construction site.
Waste Impacts	Waste impacts	litter and waste pollution on site during construction	OP	Incidents of littering were noted across the site. Some of these can be attributed to skip bins that were overflowing and vulnerable to wind as they were not covered. Windblown litter was also noted.

Air impacts	Air pollution	Construction activities will result in a large clearing of vegetation and earth moving activities, resulting in an increase in dust on site.	OP	The project conduct fallout dust monitoring survey on monthly basis. Evidence of immense dust suppression was noted.
Other	Hazardous substance pollution	If hazardous substances are spilled, they may have a negative impact on the environment.	OP	Minor spills were observed around oil drip trays under machinery.

Table C2: Medupi PS actual occurrence ratings with comments from the site observations and interviews.

Medupi Power station				
Impact category	**Predicted/ not predicted environmental impact**	**Description**	**Actual occurrence**	**Comments**
Hydrological impacts	Increased water demand	Increase in demand for water resources for the generation associated emissions control technologies e.g. FGD.	OP	The weekly average consumption is currently 26 000m³, which exceeds the amount specified in the AEL. It is understood that water for construction and operational activities is now being sourced from the completed Mokolo water pipeline.
	Poor quality surface water	Poor quality water storage on site and artificial recharge through permeable soil and weathered material into the ground water.	OP	The Sewage Treatment Plant at Medupi continues to discharge poor quality effluent and is not meeting its permit conditions. The groundwater and surface water quality is compromised.
	Ponding	Ponding of poor quality may recharge groundwater	ONP	Due to recent rains, water was noted ponding in some areas of the site. Ponding has also occurred in the temporary waste storage areas.

	spread of polluted surface water	During rainy seasons, rainwater may accumulate in the oil off-loading areas and in areas were oil spills have occurred causing oil to spread over larger areas and cause pollution.	ONP	A number of shortfalls were noted at the bulk oil off-loading area. The sump in the area is filled with water and spillages were not cleaned up properly. Spillages were also transferred into adjacent areas due to unattended oil spillages sticking to truck tyres. Storm water run-off from the main access road and parking areas pass through the waste area and hazardous substance storage area.
	Wet waste disposal	The wet waste will have the potential for leachate generation which could migrate into the underlying aquifers or form run-off and migrate off site.	OP	There were no waste skips available at the Wetback construction laydown area.
	Removal of surface water from catchment	The water used in the Flue gas desulphurisation (FGD) processes cannot be treated for discharged back into the river thus reducing the water levels in the catchments.	NP	It was not noted whether the water level in the catchments have decreased or not.
	Gypsum impact on groundwater	Gypsum manufacturing has the potential to impact negatively on the groundwater and surface water resources	NP	Gypsum has not affected the groundwater at the site.
	Water pollution	Chemicals and material used on site during construction if spilled could end up in the storm water.	OP	Instances were also recorded where hazardous substances have entered the storm water system.
	Silting of storm water drains	During the rainy seasons there may be an increase in silt in the storm water drains.	ONP	There was an increase in silt.

Flora and fauna impacts	Impact on flora	The removal of natural vegetation for construction activities and the clearing of vegetation for servitudes	OP	Vegetation removal was confined to areas that had to be cleared.
	Impact on natural habitats and species	Removal of vegetation and destruction of ecosystem attributes	OP	Some 30 to 40 animals have been relocated to an Eskom game reserve close by during the site clearance and approximately 50 remain which will be managed as part of the ecosystem after construction is complete.
	Impact on Red data species	Destruction of Red Data flora and fauna species habitats	OP	Relevant permits have been obtained for the relocation of protected/endangered plant and animal species.
	Impact on Protected trees	Destruction, removal and /or relocation of protected tree species	OP	The Baobab and many nationally and provincially protected trees were either replanted or transported to a special nursery at the adjacent Matimba power station. This included species such as camel thorns, shepherds trees, Leadwoods, Tamboti and Marulas
	Impact on sensitive habitats	Destruction of sensitive ecological habitats e.g. outcrops riparian fringes, non-perennial streams, etc.);	OP	Stockpiled materials are located away from potentially sensitive areas (such as the Afguns Road and/or the rocky outcrop, watercourse and dam area).

	Alien vegetation	Alien vegetation and weeds growing in the PS vicinity.	OP	Alien vegetation and weeds continue to be a challenge in many areas on site, especially within the road reserve of main access roads and on the banks of the northern storm water canal.
Visual & noise impacts	Visual impacts	The visibility or visual exposure of any structure or activity within the region	OP	The activities and movement of construction vehicles and personnel during the construction phase has been restricted to help prevent the reckless destruction of natural vegetation that could play an important role in the long term mitigation of visual impacts
	Noise pollution	Increase in noise levels at the construction site yards, from construction vehicles and equipment and construction staff.	OP	Noise levels are regularly monitored
Other	Soil erosion	Impact on areas with high agricultural potential due to top soil removal.	OP	The clearing of such a huge area involves massive amounts of vegetation and topsoil. The topsoil was preserved and will be used for rehabilitation
	Soil erosion (due to storm water runoff)	Erosion caused by storm water run-off from the access roads.	OP	Signs of erosion were evident at a number of areas along the main access roads.
	Hazardous substance pollution	If hazardous substances are spilled, they may have a negative impact on the environment.	OP	Hazardous substances were not always stored in bunded areas or within drip trays, and as a result several spillages occurred. Some construction equipment and machinery

				(transformers) was also noted to be leaking oil, causing several hydrocarbon spillages.
	Lighting impacts	The construction has the potential to impact on adjacent landowners.	OP	No significant light pollution was noted at night.
Waste impacts	Waste impacts	Litter and waste pollution on site during construction.	OP	A number of full/overflowing waste bins and skips, excessive littering & poor housekeeping were noted. Baboons and monkeys are adding to the waste challenge by scavenging through waste containers for food, resulting in more uncontained waste across the site. The presence of rodents and stray cats exacerbates the situation.
Air impacts	Air pollution (dust)	The construction phase will comprise land clearing and site development operations at the power station site and the associated infrastructure, specifically the ash dump. Sources of dust include wind erosion from exposed areas, fugitive dust from mining and brickmaking operations, vehicle entrainment from roadways and veld burning.	OP	Dust levels are regularly monitored, and dust suppression is regularly done on site.
	Air pollution (ash)	Fly ash spills and ash spillages	ONP	Ash spillages were observed beneath the conveyor belt.

Table C3: Ingula PSS actual occurrence ratings with comments from the site observations and interviews.

Ingula Pumped Storage Scheme				
Impact category	**Predicted/ not predicted environmental impact**	**description**	**Actual occurrence**	**Comments**
Hydrological impacts	Impact on wetlands	Potential damage to wetlands during construction and maintenance.	OP	An erosion management plan is in place to minimise the impact on wetlands.
Flora and fauna impacts	Impact on fauna	Impacts on the natural fauna in the area	OP	Eskom has taken a decision to manage the area surrounding the dams and construction sites as a conservation area.
	Impact on flora	Impacts on indigenous flora.	OP	Relocations were conducted with opportunities provided to relevant specialists
	Impact on Red data flora and fauna	Possible impact on Red Data species that may exist in the area.	OP	The Ingula conservation area hosts four of South Africa's critically endangered species (Red Data List) being White-winged Flufftail, Wattled Crane, Rudd's Lark and Eurasian Bittern. And two threatened species.
	Importation of alien vegetation	Importation of alien vegetation through building materials	OP	The removal of all alien and other vegetation permits have been granted to the Ingula PSS and are kept on record.

	Impact on avifauna in the wetland	disturbances of the avifauna in the wetland downstream	OP	Mitigation measures for disturbance of avifauna are included in the EMP whilst dedicated avifaunal research and data collecting work is ongoing in partnership with Birdlife South Africa.
Visual & noise impacts	Visual impact	Visual impacts will be significant in the local area	OP	The dam wall has been designed to blend with the environment.
	Noise pollution	There is a risk of some noise generation during the construction and decommissioning phases.	OP	Noise and its prevention and mitigation are an ongoing aspect at the Ingula PSS. Noise monitoring data are kept on record.
Air impacts	Air pollution	There is a risk of some dust during the construction phase.	OP	Dust suppression is an ongoing dust mitigation measure undertaken at Ingula PSS.
Other	Soil pollution	Creosote poles may be used during the project and may have a negative health implications and an ecological impact	NP	No negative implications of creosote have been recorded.
	Fires	The construction of the line may alter the occurrence and management of fires in the area. The change in the nature of fire hazards and events can have safety, economic and ecological implications.	NP	No recent fires have occurred on site.

	Erosion	Erosion on access roads and on-site.	OP	Erosion management is continuing according to the existing strategy, with focus on reducing the causes of the initial erosion
	Loss of agricultural potential	Restrictions on land use and activities will impact on the agricultural potential of the land.	NP	Impacts on agricultural potential were not noted.
	Impact of construction camps	The construction camps may have an impact on the natural environment.	OP	The EMP addresses all environmental impacts caused by contactors at the campsites.
Waste impacts	Waste impacts	Different kinds of solid waste should be identified and separated and properly disposed on site	OP	Both hazardous and general waste was found standing without a containment bund, whilst the drum is filled and completely open at the top. Bins are secured and have lids. Where required, bins/drums containing liquids are stored inside bunded facilities.