Eskom	Guideline	Technology

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FIGURES

TABLES

1. INTRODUCTION

This guideline is a revision of the Eskom's Integrated Water and Waste Management Process guideline (240-55864856). Eskom's operations or sites undertaking water uses as per section 21 of the National Water Act (No. 36 of 1998) are required to compile an Integrated Water and Waste Management Plan (IWWMP) outlining actions required to be implemented to prevent, minimise and mitigate impacts of the activities on the water resources.. In addition, DWS has published an IWWMP guideline generic for all the water users as the reference document for the information requirements and template for the water use license application. In consideration of this requirements and changes in water and water-related legislation, the review of the Eskom's Integrated Water and Waste Management process guideline was necessary.

The revised IWWMP guideline seeks to:

- Standardize the information that should be included in the IWWMP across the business;
- Provides a framework for ensuring compliance monitoring with the water use license conditions;
- Provides a framework for the definition of the water and waste management objectives, risks and corrective measures, and;
- Provide a technical document framework that should be used for the purpose of applying for the water use license with DWS.

2. SUPPORTING CLAUSES

2.1 SCOPE

This guideline provides a framework for the development of IWWMP for operations that have to apply for the water use licenses and to ensure compliance with the water use license conditions. It also covers information relevant to Eskom for activities across the water value chain as outlined on **Figure 1** i.e. from abstraction, use and reuse as well as associated impacts on the water resources.

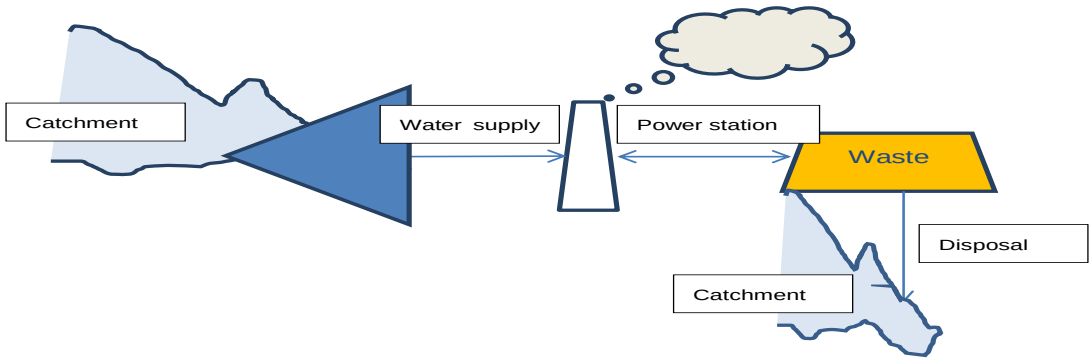

Figure 1: Eskom's water value chain

2.1.1 Purpose

This guideline has been compiled to provide guidance on the standard approach for information relevant to Eskom sites in the development of the IWWMP and to ensure compliance to the water use license conditions.

2.1.2 Applicability

This guideline shall apply to Eskom business areas where the water use license application is required and where there is an existing water use license in place of which the site is required to comply with the water use license conditions.

2.1.3 Effective date

The guideline is effective from the authorisation date.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] Constitution of the RSA. (Act 108 of 1996)

[2] Department of Water and Sanitation, Operational Guideline: Integrated Water and Waste Management Plan (2010).

[3] Eskom, Groundwater Governance Guideline (2015).

[4] Eskom, Water Accounting Framework Directive (2014).

[5] Eskom, Integrated Water and Waste Water Management Process Guideline (2016).

[6] Eskom, Matla Power Station's Integrated Water & Waste Management Plan (2012).

[7] Department of Water and Sanitation, Best Practice Guideline – G1: Stormwater Management (2006).

[8] Department of Water and Sanitation, Best Practice Guideline – G2: Water and Salt Balances (2006).

[9] Department of Water and Sanitation, Best Practice Guideline – G3: Water Monitoring Systems (2007).

[10] Department of Water and Sanitation, Best Practice Guideline – A4: Pollution Control Dams (2007).

[11] Department of Water and Sanitation, Guidelines for the Utilisation and Disposal of Wastewater Sludge, Volume 3: Requirements for the on-site and off-site disposal of sludge of wastewater sludge (2007).

[12] Government Notice 704 June 1999. National Water Act. (Act 36) of 1998. Regulations on water use for mining and related activities, aimed at the protection of the water resource.

[13] ISO 9001 Quality Management Systems

[14] 32-391: Integrated Risk Management Frameworks and Standards

2.2.2 Informative

None

2.3 DEFINITIONS

Definition	Description
Catchment	Means a catchment as defined in the National Water Act, 1998 (Act No. 36 of 1998).
Disposal	A process of undertaking a Section 21(g) water use
Environmental Impact Assessment: (EIA)	A process of examining the environmental effects of development.
Pollution	Means pollution as defined in the National Water Act, 1998 (Act No. 36 of 1998).
Water management	The process which embraces the management of both quality and quantity of natural and treated waters, including the protection, conservation, use, development and control of water resources throughout the life cycle of any facility used to generate, transmit or distribute electrical power.
Water resource	Means water resource as defined in the National Water Act, 1998 (Act No. 36 of 1998).
Water supply	A process of abstracting water from a water resource and transporting it through a pipe, canal or any other conveyance structures for use at the power plant.
Water use	Means water use as defined in Section 21 of the National Water Act, 1998 (Act No. 36 of 1998).
Water use license	Entitlement to undertake any one or a combination of Section 21 water uses of the NWA for a limited period.
ZLED	This means taking all reasonable measures to prevent pollution of water resources by the establishment of a hierarchy of water uses based on quality. Cascading the water from higher quality to lower quality users/uses enables high rates of re-use. Where possible, water is lost only by evaporation and seepage through unlined facilities. The net result is that no deliberate discharge of pollutants to a water resource under normal operating conditions and average climatic conditions take place.
Environmental Impact Assessment: (EIA)	A process of examining the environmental effects of development.
Waste Classification	The process as prescribed by the Norms and Standards from the NEMWA for the assessment of waste for the landfill disposal.
Water management	The process which embraces the management of both quality and quantity of natural and treated waters, including the protection, conservation, use, development and control of water resources throughout the life cycle of any facility used to generate, transmit or distribute electrical power.
Water resource	Means water resource as defined in the National Water Act, 1998 (Act No. 36 of 1998).
Water supply	A process of abstracting water from a water resource and transporting it through a pipe, canal or any other conveyance structures for use at the power plant.
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Definition	Description
	quality. Cascading the water from higher quality to lower quality users/uses enables high rates of re-use. Where possible, water is lost only by evaporation and seepage through unlined facilities. The net result is that no deliberate discharge of pollutants to a water resource under normal operating conditions and average climatic conditions take place.

2.3.2 Disclosure Classification

Controlled Disclosure: Controlled Disclosure to External Parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
BPG	Best Practice Guideline
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
IWRM	Integrated Water Resource Management
IWWMP	Integrated Water and Waste Management Plan
L/USO	Litres of water used per unit of electricity sent out, L/kWhr
NEMWA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NWA	National Water Act, 1998 (Act N0. 36 of 1998)
WULA	Water Use License Application
ZLED	Zero Liquid Effluent Discharge

2.5 ROLES AND RESPONSIBILITIES

None

2.6 PROCESS FOR MONITORING

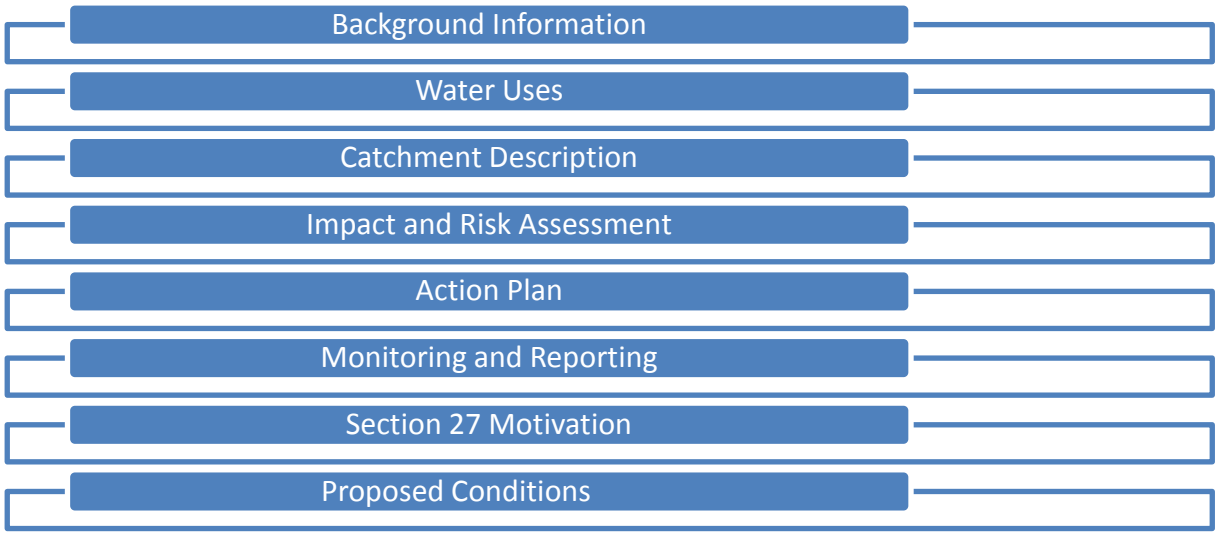
This document will be monitored by means of audits and during its annual review.

2.7 RELATED/SUPPORTING DOCUMENTS

None

3. WATER MANAGEMENT GUIDELINE

The guideline describes Eskom specific information necessary to meet the requirements of the DWS IWWMP guideline which is designed in a logically simplified format listing the management actions necessary to prevent and minimize pollution of water resources. The guideline describes the nature of the activity, applicable water uses, baseline environmental conditions, observed changes to baseline conditions due to the operations and future projections when assessed against the desired end-state or standards, action plan to prevent, minimize and improve the condition to within the desired state or standards, monitoring program to check effectiveness of the actions and motivation for the issuance of the water use license. Thus, as a minimum, the WULA report should be structured to cover the following elements:



Besides providing information required for the water use license application, the guideline should be used to present key information necessary to build up a logical argument and justification for the selection and implementation of the proposed action plans. The next sections provide the detailed description of each element of the IWWMP.

The development of the IWWMP should be guided by the following principles:

- The IWWMP must be aligned with Eskom's corporate water management initiatives, policies, and strategies and regulatory requirements to ensure legal compliance and implementation of industry best practice.
- The IWWMP must looks at how to minimise the water and waste management costs by optimising the efficiency of water and waste management systems, thus minimising adverse environmental and social impacts related to water and waste management'
- The IWWMP must define clear responsibility and accountability for the execution of water and waste management related activities;
- The IWWMP must also serves to document the methods employed and the management of water and waste related emergencies that may arise.

- The IWWMP must be updated to ensure that water and waste activities on site are managed in an integrated manner and that there is a plan of action in place to ensure water and waste related issues will be addressed in a structured progressive manner to achieve site specific objectives related to the management of water and waste.

3.1 BACKGROUND

A detailed description of the project and activities associated with water uses should be presented in this section. This section should include the following information:

- Brief description of the power generating process with focus on the raw materials (type and source or availability), water use and wastewater management;

- Technology type (coal, nuclear, hydro, solar etc), output (generation capacity) and operating period
- Main water management facilities and related infrastructure in terms of supply, storage, treatment and waste disposal systems.

- Power generation process and steam cycle;
- Process water balance diagram or flow chart to summarise is shown in **Fig 2** below.
- Contact details of the applicant and holding authority (Refer to **Table 1-1** and **Table 1-2** below)
- Regional setting and location of activity (including locality map)
- Table of list of properties and associated infrastructure (**Table 1-3**);
- Summary of Existing and Lawful Water Use(ELWU) and new water uses;
- The purpose of the IWMMP; and
- Contextualisation of the activities.

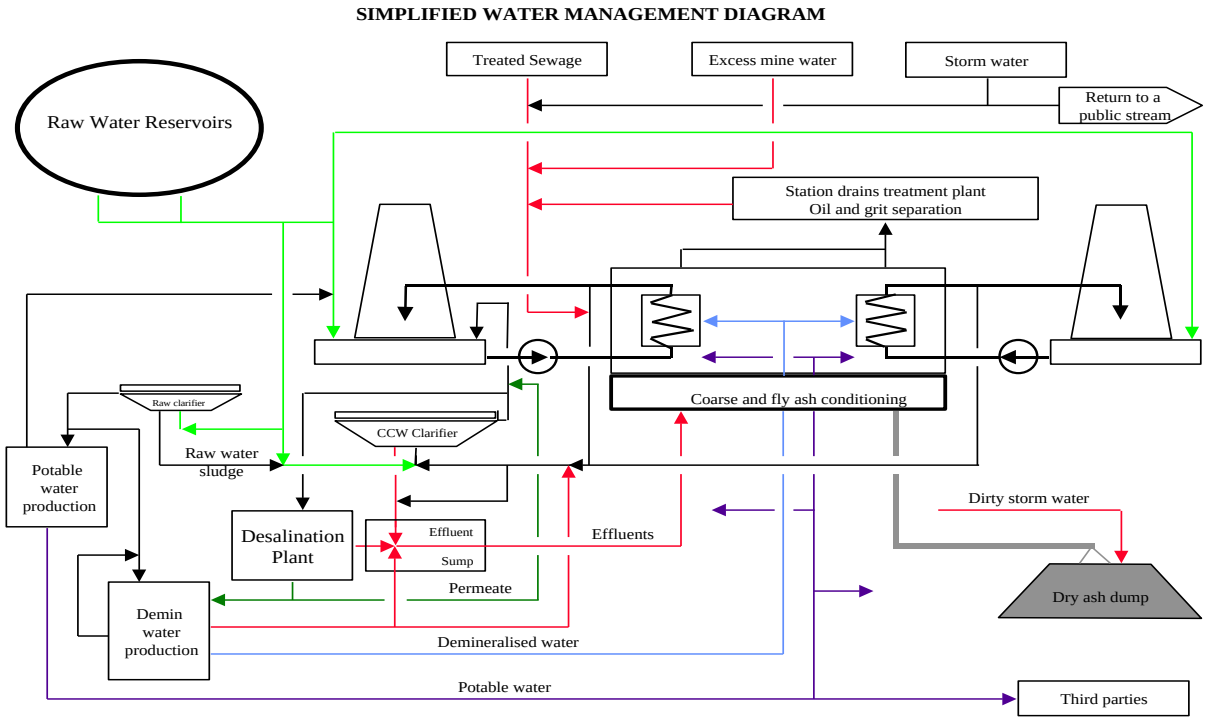


Figure 2: Process water flow diagram for typical coal fired power plant

Table 3-1: Applicant Details

Company name:	Eskom Holdings SOC Ltd
Postal address:	P.O. Box 1091 Johannesburg 2001 Megawatt Park
Physical address:	Maxwell Drive Sunninghill, Sandton 2000

The contact details of the holding authority are contained in **Error! Reference source not found.**.

Table 3-2: Contact Details of the holding Authority

Contact person	Name of the Environmental Manager
Contact number	
Applicant	Power Station
Power Station General Manager	
Contact Number	
Email address	
Fax number:	
Address	Power station address

Table 3-3: Land Tenure of the Proposed Project

Farm Name	Farm No.	Portion	Size (ha)	Owner	Title Deed

3.1.1 Purpose of the IWWMP

The purpose of the IWWMP can be in two folds:

- To support the water use application as required for the identified water use(s) (described in Section 3.2) as per the Section 21 of the NWA; and

- To fulfil the condition of the water use license condition which require submission of the IWWMP after the issuance of the water use license and thereafter annual submission of the updated IWWMP.

3.2 WATER USE

The Section 21 of the NWA lists eleven (11) water uses that must be authorised before anyone can undertake an activity that uses water. These are defined as follows:

Water Uses	Description
Section 21(a)	Taking water from a water resource
Section 21(b)	Storing water
Section 21(c)	Impeding or diverting the flow of water in a watercourse
Section 21(i)	Engaging in a stream flow reduction activity
Section 21(e)	Engaging in a controlled activity
Section 21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit
Section 21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource
Section 21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process
Section 21(i)	Altering the bed, banks, course or characteristics of a watercourse
Section 21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons
Section 21(k)	Using water for recreational purposes

Typical water uses associated with Eskom business are provided in the table below:

Water Uses	**Example of Eskom Activities**
Section 21(a)	Abstraction of water from the catchment dams which are transported and stored in the raw water reservoirs at the power station. Primary Energy Division usually applies for this water use working together with the business units and Sustainability Division (Water Centre of Excellence).
Section 21(b)	Storing water -storage of raw water into the raw water reservoirs at the power stations or sites
Section 21(c)	Impeding or diverting the flow of water in a watercourse – construction of the infrastructure near or within the watercourse[1].
Section 21(e)	Engaging in a controlled activity : • Engaging in a stream flow reduction activity – generation of electricity by altering the flow regime of a water resource, i.e. hydro power. Irrigation of any land with waste or water containing waste which is generated through an industrial activity or a waterworks – applicability of this water use should always be confirmed with DWS through the pre-application meeting as DWS regulates this differently in the case of irrigation of lawns at the site or for the purpose of rehabilitation where crops will be planted.
Section 21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit – discharge of treated effluent water from the sewage plant or water containing waste from the site pollution control dam.
Section 21(g)[2]	Disposing of waste in a manner which may detrimentally impact on a water resource – ash dump, emergency ash and temporary coal storage, pollution control dams (clean/dirty storm water dams) and coal stockyards.

[1] A wetland delineation study is required to confirm if there are wetlands/water resources on-site to evaluate if Section 21(c&i) is likely to be triggered

[2] In terms of waste the definition of the waste act shall apply.

Section 21(h)[2]	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process - applicability of this water use should always be confirmed with DWS through the pre-application meeting as DWS regulates this differently in the case of effluent water generated from the water treatment plants.
Section 21(i)	Altering the bed, banks, course or characteristics of a watercourse – this water use goes together with Section 21(c)
Section 21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons – this water use is applicable for the site that drill underground and likely to hit the groundwater level. For example, the construction of the tunnel.
Section 21(k)	Using water for recreational purposes – the site that wants to use the water resources within the site boundaries for recreational purposes. There was such proposal for Ingula Project

Note:

a. Infrastructure and associated activities may trigger more than one water use(s). Therefore an integrated water use authorization may be required.
b. Establish if water uses are existing or new. Verify if authorisation exists and is valid. If so, no need to apply for a new water use authorisation. If not, apply for the authorisation.
c. Authorisation may not be necessary if water use is defined as an Existing Lawful Water Use or is considered a General Authorisation.

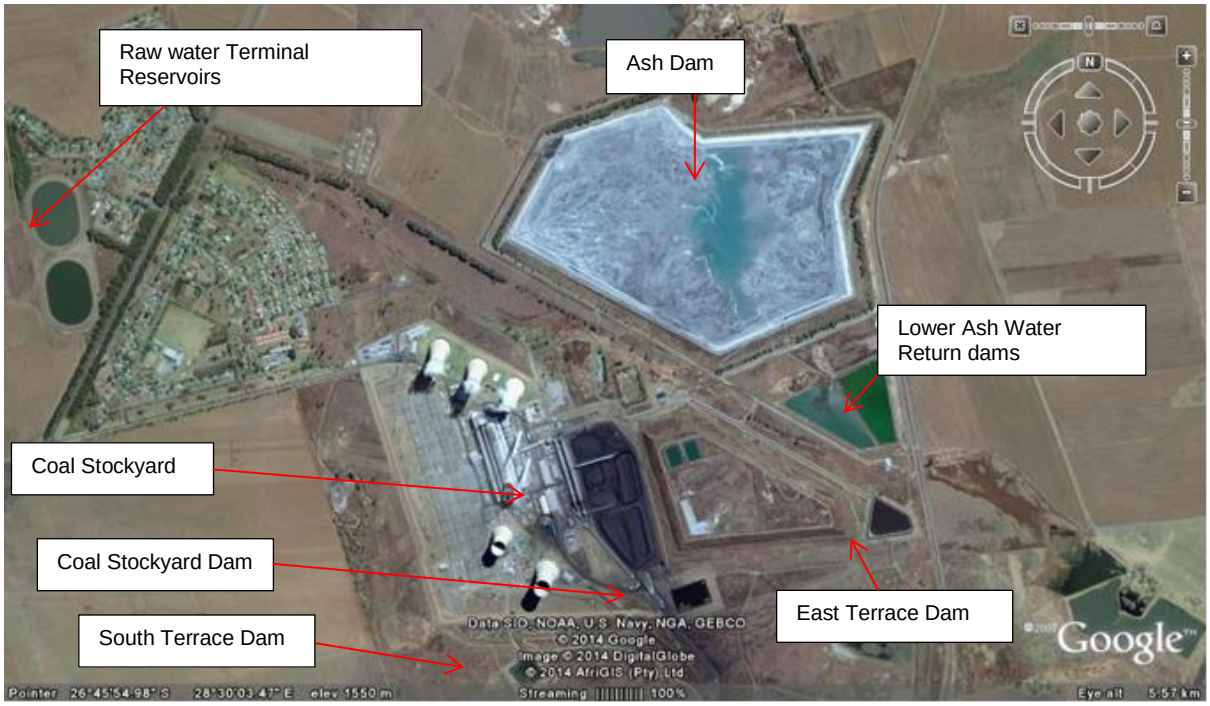


Figure 3: Aerial view of Grootvlei Power Station with associated infrastructure

Water Uses	**Grootvlei Water Uses**
Section 21(a)	Activity undertaken by Randwater on behalf of the power station
Section 21(b)	Raw water Terminal Reservoirs
Section 21(c)	Power Station built on the wetland
Section 21(i)	N/A
Section 21(e)	N/A
Section 21(f)	N/A. Sewage plant handed over to Local Municipality and they discharge treated effluent into the environment
Section 21(g)	Ash Dam, High water return dams, Lower Ash Water Return Dams, East Terrace Dam, Coal Stock Yard, Coal Stock Yard Dam and South Terrace Dam.
Section 21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process-discharge of the effluent from the water treatment plant into the ash dam.

Section 21(i)	Altering the bed, banks, course or characteristics of a watercourse - power Station built on the wetland -
Section 21(j)	N/A
Section 21(k)	N/A

Once the water uses have been identified and confirmed with DWS via the Pre-application process defined under water use licensing process then the applicant must complete the water use forms which can be downloaded from DWS website

(http://www.dwa.gov.za/Projects/WARMS/Registration/registration1.aspx).

The forms must be attached to the IWWMP if the IWWMP is compiled in support of the water use license application.

Table 3-4 shows example of the format for presenting water uses and authorisation status for the WULA.

Table 3-4: Water uses and authorisation status

Ref no	Farm name	Title deed numbers	Description of Water Use	Water Resource	Volumes abstracted/ discharged per day/ Storage capacity m^3	Latitude	Longitude	Authorisation Status
Section 21 (c) & (i):								

3.3 CATCHMENT DESCRIPTION

Environmental baseline condition for the site is presented in this section to provide information prior to the commencement of the activity or project. The catchment baseline information is critical in evaluating the impacts that are likely to occur as the result of project or activity implementation. Further, it provides crucial information for the identification of mitigation measures that will be required if the project or activity will impact on the water resources. The crucial information to include in this chapter is:

a) Climatic conditions – provides information on rainfall and evaporation rates essential for hydrological assessment such as extent flooding in the area and infrastructure capacity requirement to handle heavy rainfall events;
b) Topography – this provides information on natural surface and groundwater flow direction of the area;
c) Geology and Soils – provides information that is critical for stability of the area and any sensitive ground water structures that influence rate of pollutant migration
d) Surface Water (hydrology and water balance)/ Aquatic Ecology – summarise the surface water in the area, i.e. streams/ rivers/ wetlands/ drainage lines/ flood lines/ pans as well as both their ecological present state and sensitivity.
e) Groundwater and groundwater pollution plume – summarise the groundwater status in the area. For the site where ground water monitoring boreholes data is not available, the site needs to establish the monitoring boreholes in advance in order to include the baseline information in the water use license application.

Key information required for this section is rainfall, temperature, wind and evaporation. However, only evaporation and rainfall data is an input in the water balance, hydrological studies as part of the impact assessment section of the IWWMP. The data can be represented as follows:

Table 3-5: Rainfall and Return Period Rainfall (average in mm)

Month	Rainfall (mm) (1905-1992) ID <<Closest rainfall station gauge>> can be sourced from SAWS or Hydrological report		
	Average	Maximum	Minimum
October	64	171	0
November	108	281	16
December	99	263	4
January	108	242	18
February	83	224	0
March	72	180	0
April	40	179	0
May	17	163	0
June	5	75	0
July	5	67	0
August	8	60	0
September	19	143	0

Month	Rainfall (mm) (1905-1992) ID <<Closest rainfall station gauge>> can be sourced from SAWS or Hydrological report		
	Average	Maximum	Minimum
Totals	628	2048	38

Duration	Return Period Rainfall (average in mm)						
	2	5	10	20	50	100	200
24 hour	58	78	92	106	126	142	159
1 day	49	66	78	90	107	121	135
2 day	61	81	95	109	128	142	157
3 day	68	90	104	119	139	155	171
4 day	73	95	111	127	147	163	180
5 day	79	103	119	136	157	174	190
6 day	83	107	124	140	162	178	195
7 day	87	113	130	147	169	185	202

The <<Name of the quaternary catchment>> experience a Mean Annual Evaporation (MAE) of approximately <<reported figure>> mm per annum (Midgley et al,. 1994).

Catchment areas and the Mean Annual Runoff (MAR) for the main rivers are presented in Table 3 6. Loss of MAR to the <<Name of the catchment>> due to containment of dirty water in the project area is considered significant at <<percentage amount of captured runoff>> (Eskom, 2012).

Table 3-6: Catchment areas and the Mean Annual Runoff (MAR) for the main rivers

River Name	Area (km^2)	MAR (mill m^3)
Riet Spruit catchment	467	15.1
Steenkool Spruit catchment	551	16.6

Note 2:

Rainfall, evaporation and runoff information can be obtained from the hydrological study report.

This section should also be dedicated to current status of surface and groundwater quality in the nearby streams and boreholes downstream of the catchment Reference (BPG Surface and groundwater monitoring).

Should adequate information be available, provide more detail in terms of the existing users, historical trends and possible source of impacts.

Above information will then be used in the next section to predict any impact from the said activity.

Note 3:

Most information in this section can be sourced from existing reports such as the surface and groundwater monitoring reports.

3.4 IMPACT ASSESSMENT AND PROCESS AUDITS

Impact on the water resources can only happen when there is a discharge (overflow) of effluent or seepage from a waste disposal facility. Water uses that will result in these conditions are:

- Raw water storage;
- Effluent discharge; and
- Disposal of effluent;

In order to prevent these water uses from impacting on the water resources, the discharge (overflow) of effluent or seepage must be prevented, minimised and reduced. This is done by identifying the root cause of the impact and developing mitigation measures to prevent; minimise and reduce the impact. Impact assessment studies serve as useful tools to develop these measures. Table 2 shows impact assessment studies and their outcomes. However, it should be noted that outcomes of these studies are only limited to identification of design and disposal infrastructural defects. At times the risks of discharge of effluent could be caused by operational inefficiencies which might be omitted as additional root cause. This gap is addressed by undertaking process audits.

It should also be noted that operational inefficiencies do not immediately result in effluent discharges. They should rather be considered as root causes that could lead to water uses impacting on the water resources. Therefore process audits are useful tools for operational activities while impact assessments assist with identification of requirements for new and old infrastructure to manage pollution.

Figure 4 shows the two types of assessments for causes of pollution and the respective nature of their outcomes.

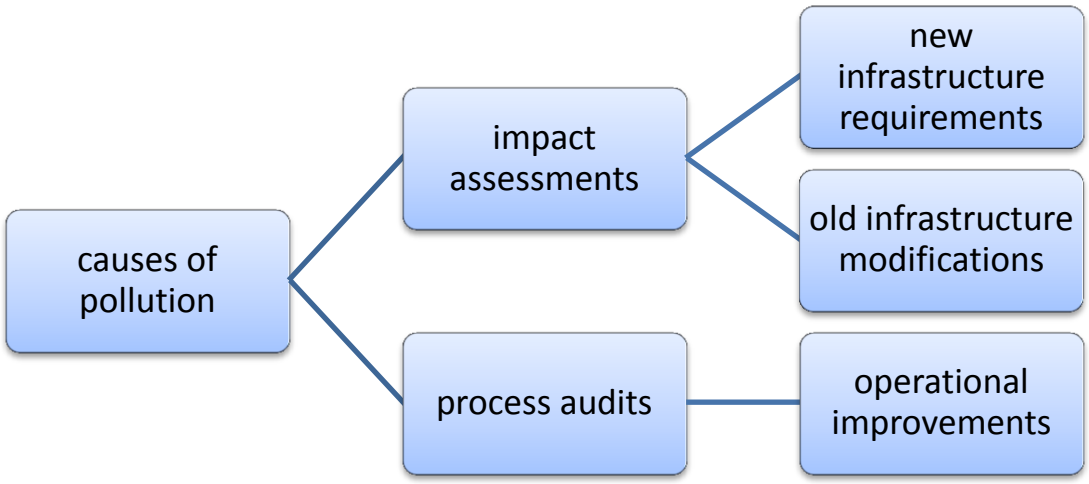


Figure 4: Two types of assessments with the nature of their outcomes.

3.5 IMPACT ASSESSMENT

Section 3.2 identified a list of water uses that could have an impact on the water resources in the catchment. The impact on the water resources is defined as pollution of water resource to unacceptable levels and reduction of amount of water available in the catchment. Each water use can result in one or two of the aforementioned overall impacts.

The NWA defines pollution as the direct or indirect alteration of the physical, chemical or biological properties of a water resource so as to make it -

(a) less fit for any beneficial purpose for which it may reasonably be expected to be used; or

(b) harmful or potentially harmful -

- to the welfare, health or safety of human beings;
- to any aquatic or non-aquatic organisms;
- to the resource quality; or
- to property;

In the context of the above definition, a water use is considered to have an impact on the water resource if it has altered the physical, chemical or biological properties of nearby water resources. Therefore this section utilise the previous section's information relating to the type of the water use (section 3.2) and conditions before the impact (section 3.3) to quantify the impact. The impact can be quantified by the following methods:

- Comparison of upstream with downstream monitoring data for active water uses;
- Comparison of catchment water resource quality objectives with downstream monitoring data for active water uses;
- Impact prediction using groundwater pollution plume models showing changes in conditions in a study area over a specific time period (e.g. current to post-closure) for new and active water uses.

The above methods assume all water uses continuously release pollutants into the environment. However, in practice only section 21 (f) water use and to a lesser degree 21 (e), (h) and (g) water uses release pollutants while section 21 (a), (b), (c) and (i) and (j) do not release pollutants.

The impact from the latter will mainly relate to the flow which could have secondary effect of increased pollutant if flow levels are low compared to pre-existing conditions and vice-versa.

Studies critical to assess the impact of various water uses are presented in **Table 3-7** below.

Table 3-7: Studies critical to assess the impact of various water uses and associated outcomes

Study	Section 21 Water Use in terms of the NWA	Input	Outcomes
Hydrology and water balance	21 (a), b), (c) & (i), (f) & (g); 21 (a);	Process water balance, site plans and engineering designs and process water balance	Recommends 1:100 years flood-lines and storage or disposal capacity requirements to comply with 1:50 and 0.8m freeboard Recommends Flood and erosion management best practices
Wetland delineation	21(c) & (i)	Site plans and concept designs	Master plan showing wetland boundaries, 500m buffer zones and infrastructure location as well as current condition of the wetland and its ecological importance. Recommends the preferred site and size and shape of project area (footprint) to avoid encroachment on the wetland buffer.
Waste classification & Characterisation[3]	21 (g)	All waste produced on site (both solid and liquid)	Recommends type of a liner for a specific disposal facility. Alternatively, is an input to groundwater model.
Groundwater model	21 (g)	Surface and groundwater monitoring reports	Fate of plume migration required for decision on mitigation measures

Note 3: Waste Classification and Characterisation – minimum waste to be classified can be listed here

d. Identify waste streams (liquids and solids)
e. Characterized waste (Appendix of list of waste streams) in terms of Norms and Standards
f. Sewage Sludge is characterized using the Water Research Commission (WRC) Guidelines should it be required for rehabilitation.
g. Normal SANS methods should be for laboratory analysis of effluent (liquid) streams

it is in line

3.6 PROCESS AUDITS

When pollution or impact on water resources has not yet materialised, process audit is undertaken to establish a baseline. However, one needs to define the risks before an assessment can be undertaken. For impact to take place, two conditions needs to be satisfied:

a) Discharge to surface water resource; and or
b) Seepage to underground resource

The above conditions can be defined as Risks. Causes are any situations that could lead to the above conditions to materialise. These Causes can be related to the actions required to mitigate the risks.

Root-cause analysis method can be used to identify these causes based on the following sources of information:

- Process water balance and Water Accounting Framework (WAF);

The Water Accounting Standard should be consulted to determine the minimum number of streams to be monitored for a credible water balance. The critical flow meters must also have a calibration and verification schedule in line with the requirements of the water accounting standard.

and

- Water management review reports.

Root-cause analysis will identify causes that can be translated into actions necessary to mitigate the risks. This can be illustrated according to **Figure 5** and **Figure 6** below:

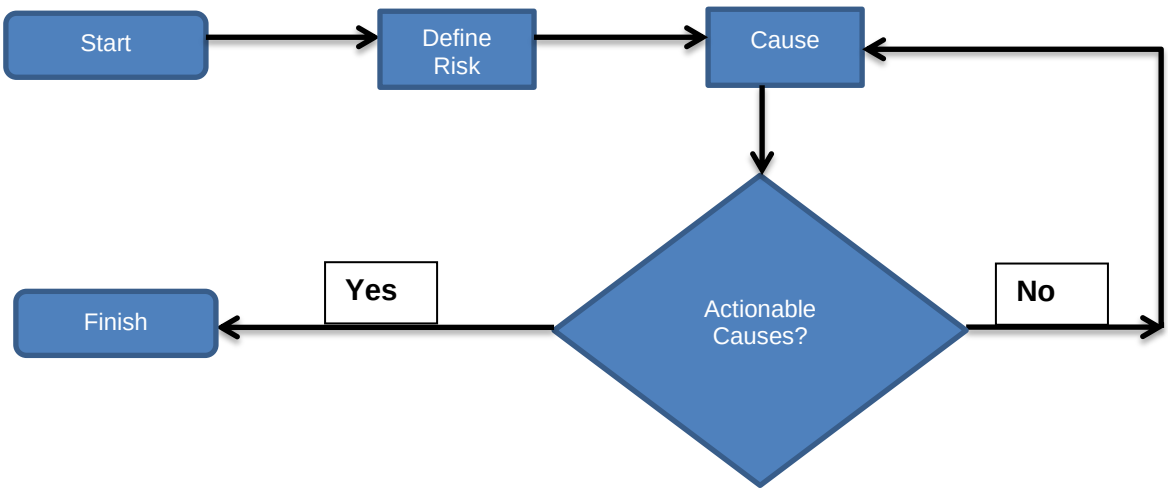


Figure 5: Framework for Root Cause Analysis to Actionable Items

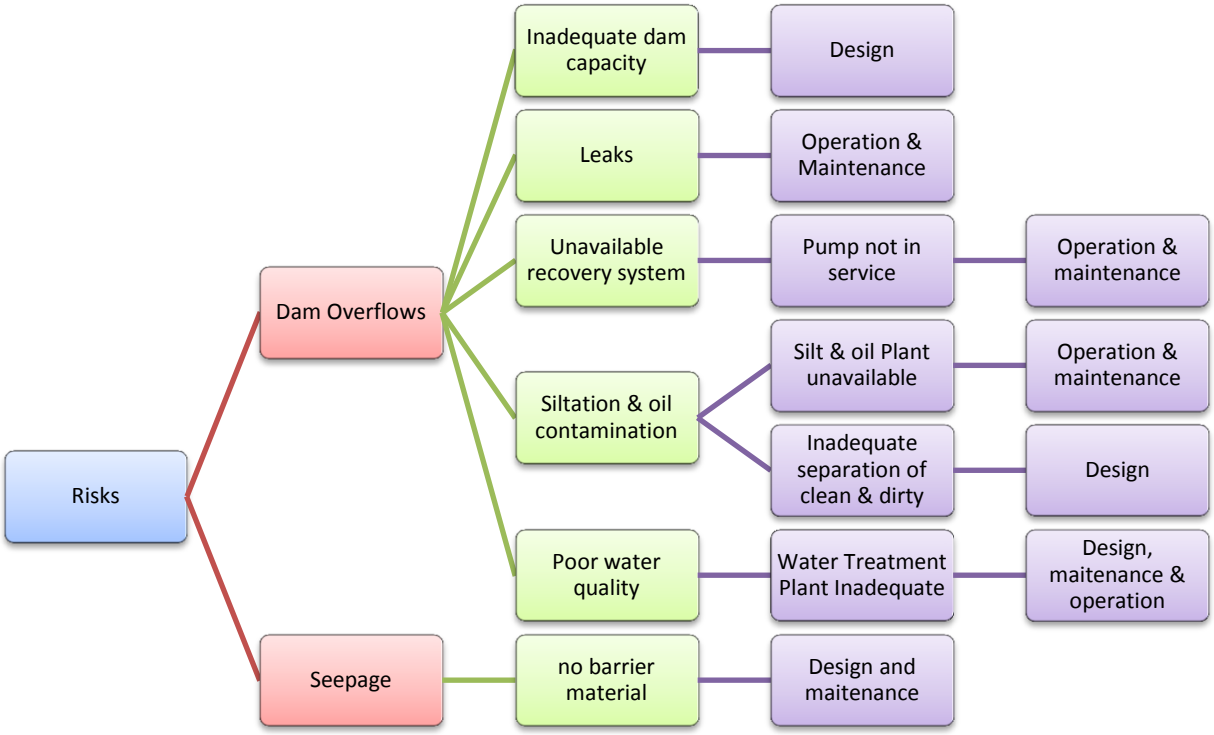


Figure 6: An example of a Root Cause Analysis to drill down to actionable items

A list of these Causes can be generated through evaluation and analysis of the water balance and water management reports. Risk assessment can then be undertaken to evaluate the risk rating for each aspect and to inform action plan of the IWWMP. Eskom risk matrix can be adapted to rate the significance of each risk and prioritise actions.

3.7 RISK ASSESSMENT METHODOLOGY

A workshop approach should be employed to establish the risk profile of the operations at the power station. The methodology followed is summarised and depicted in Figure5.

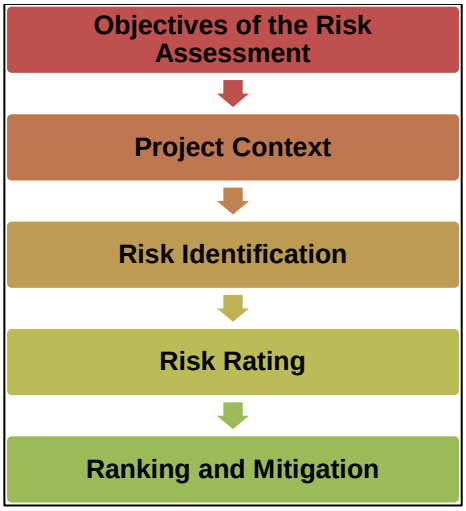


Figure 7: Risk Assessment Methodology

3.7.1 Risk Assessment Objectives

The objectives of the risk assessment should be confirmed by the workshop participants. The primary objective is to meet the requirements of the IWWMP and the additional objectives are listed as follows:

- To identify all the high level water and waste related risks for project;
- Develop a risk profile for project;
- Develop proactive approach to dealing with Risks (potential negative impact);
- To generate information for on-going risk assessment.

3.7.2 Risk Assessment Context

The project context is set through discussion with the workshop participants the following is considered:

- All current and new activities associated with the project is considered; and
- The assessment utilised the information currently at hand at the time of the assessment.

3.7.3 Risk Identification

The workshop should follow a brainstorming approach to the identification of risks. As risks are identified they are recorded in the risk register. In most cases the identified risks are either consolidated with an existing item or are recorded as a stand-alone risk item. The identified risks form the basis of the risk register.

3.7.4 Risk Rating/Analysis

Each risk is rated on two scales: Likelihood and Consequence. The likelihood criteria and scale is summarised in **Table 3 8** while **Table 3 9** provides a summary of the consequence criteria and scale used during the risk analysis.

Table 3-8: Risk Management Likelihood Criteria

Likelihood Criteria	
Scale	**Description**
1 (A)	- < 5% probability
	- Occurrence requires exceptional circumstances
	- Exceptionally unlikely, even in the long term future
	- Only occur as a '100 year event'
2 (B)	- >5% probability
	- or may occur but not anticipated,
	- or could occur in 'years to decades'
3 (C)	- >20% probability,
	- or may occur shortly but a distinct probability it won't,
	- or could occur within 'months to years'
4 (D)	- >50% probability,
	- or balance of probability will occur,
	- or could occur within 'weeks to months'
5 (E)	- 99% probability,
	- or impact is occurring now,
	- or could occur within 'days to weeks'

Table 3-9: Risk Management Consequence Criteria

Consequence	1	2	3	4	5	6
Financial Impact	< R100k loss or gain.	R100k - R1m loss or gain	R1m -R99m loss or gain	R99 - R999m loss or gain	R999m – R150b loss or gain	R150b+ loss or gain
People Effects	First aid treatment or minor medical treatment.	~Medium term largely reversible disability to one or more persons ~Significant medical treatment, disabling or lost time injury <2 weeks.	Extensive injuries or irreversible disability or impairment to one or more persons.	~Single fatality and /or ~Severe irreversible disability to one or more persons	~Multiple fatalities, or ~Significant irreversible effects to 10's of people.	~More than 10 fatalities, or ~Many 10's of people subjected to irreversible effects.
Environment	~Negligible impact on the environment, little to no ecological effect and no measurable impact on human health. ~Impact limited to site. ~Remediation within one day.	~Short term transient environmental or community impact-some clean-up costs. ~Impact extends beyond site boundaries to immediate surrounds. ~Remediation within one week.	~Medium term recovery, immaterial effect on environmental/community. ~Required to inform Government agency. (e.g. noise, dust). ~Impact extends to adjacent community. ~Remediation within one year.	~Measurable environmental harm – medium term recovery. ~High potential for complaints and from stakeholders and community. ~Environmental directives issued by authorities. ~Regional impact. ~Remediation within three years.	~Prolonged environmental impact. ~High-profile community concerns raised - requiring significant rectification measures. ~Government agency inquiry. ~Environmental licences revoked and directives issued. ~National impact. ~Remediation within three to ten years.	~Irreversible long term environmental harm. ~Community outrage-potential large scale class action. ~Public inquiry by Government agency. ~Environmental licence revoked. ~Potential for significant legal sanctions against Eskom. ~International impact. ~Remediation greater than ten years.
Brand and Reputation	~Entirely an internal issue. ~Attention is confined to site.	~Event that site management can readily manage internally. ~No press reporting or external interest. ~Disciplinary action may be taken.	~Serious event that can be readily managed but management effort is still required to minimise impact locally. ~Adverse local press reporting. ~ Disciplinary action likely.	~Major event that causes adverse local press reporting – over several days. ~Manager may be asked to leave. ~Minister raises concerns.	~Significant event that would require on-going management and brings the organisation into the national spotlight. ~Sustained adverse national press reporting over several days. ~Sustained impact on the reputation of Eskom. ~Loss of Government support. ~Executive management restructure.	~Critical event that the organisation would be forced to undergo significant change. E.g. CE departs and Board is restructured. ~Sustained adverse international/national press reporting over several weeks. ~Prolonged loss of Government confidence and community support.
Legal and Compliance	Minor deviation from intent of the law	Minor legal issues, non-compliances and breaches of regulation.	Breach of regulation with investigation or report to authority with prosecution and/or	~Major breach of regulation with punitive fine. ~Significant litigation	~Major litigation costing R10m+. ~Investigation by regulatory body resulting	~Major litigation or prosecution with damages of R100m+ plus significant costs.

Consequence	1	2	3	4	5	6
			moderate fine possible.	involving many weeks of senior management time.	in long term interruption to operations. ~Possibility of custodial sentence.	~Custodial sentence for company Executive. ~Prolonged closure of operations by authorities.
Continuity of Supply	Loss of supply to some customers (normal interruption) affects 3,000 customers for <4hrs	Loss of supply to large customer or affecting > 10,000 customers for <4hrs	Local loss of supply affecting >10,000 customers (>50MW) for >12hrs	~Regional blackout lasting < 6 hrs. ~National load shedding <2wks. ~Loss of supply to major centre or customer for >12hrs.	~Unexpected o Regional blackout lasting <6hrs. o Under-frequency event resulting in voluntary and mandatory load shedding. ~Expected o National load shedding <4wks. o Loss of critical supply to critical customer (deep level mines, smelters etc.)	~National blackout with enormous impact on country from image, economic, point of view. ~National load shedding > six months.
Project Cost	>0 - 2%	>2 % - 5%	>5% – 9 %	>9% – 19 %	>19% – 29 %	>29% – 100 %
Schedule	< 1 week	1 Week – 4 Weeks	1 Month – 6 Months	6 Months – 1 year	1 year – 2 years	2 years >
Quality	Minor - Slight deviation from specified requirements. Has no overall impact on usability/standards.	Moderate- Requirement not met but requires concession. Failure to include certain elements promised to stakeholders.	Significant - Standard requirements not met and rework needed. Significant elements of scope or functionality are affected.	Substantial-Major non-conformance resulting in scrapping of product. Product that is not fit for the purpose.	Severe – Major none conformance that would results in a few chain reaction, negatively impacting project outcome.	Catastrophic-Major non-conformance that would results in a chain reaction that have huge negative impact on the plant. Project outcomes effectively unusable

3.7.5 Rating and Priority

The risks are ranked according to a matrix which is shown in **Table 3-10** and the order of priority (importance) of the risk is presented in **Table 3-11**. The risk management assessment matrix is based on the combination of likelihood and consequence.

Table 3-10: Risk Management Assessment Matrix and Priority Levels

Consequence	**6**	**III**	**II**	**I**	**I**	**I**
	5	**III**	**II**	**II**	**I**	**I**
	4	**IV**	**III**	**II**	**I**	**I**
	3	**IV**	**III**	**II**	**II**	**I**
	2	**IV**	**IV**	**III**	**II**	**II**
	1	**IV**	**IV**	**III**	**III**	**III**
		A (1)	**B (2)**	**C (3)**	**D (4)**	**E (5)**
		Likelihood				

Table 3-11: Priority level of risks

Priority of Risk		
Priority	**Suggested timing of treatment**	**Authority for continued toleration of residual risk**
I	Short Term, Normally within 1 month	Board, Chief Executive and Managing Directors
II	Medium Term, Normally within 3 months	Managing Directors, Senior General Managers and General Managers
III	Normally within 1 year	Senior General Managers ,General Managers and Managers
IV	On-going control as part of a management system	All staff

The risks which are identified and recorded are summarised in **Table 3-12**. For each risk an action plan should developed and presented as in **Table 3-12.**

Table 3-12: Risks and Action Plan

Risk Description	Aspect / Causes	Objective	KPI	Mitigation	Responsibility	Due Date
Unauthorised effluent discharge	Water Quality	Water use efficiency	Achieve water use performance target	Upgrade WTP	Engineering	2019
	Inadequate Design			Increase dam capacity	Engineering	2021
	Operational Inefficiency			Dredging and increase recovery	Ops and Maintenance	On-going

3.8 MITIGATION MEASURES

This section should list actions/mitigation measures based on the outcome of the risk assessment reports. In addition, development of mitigation measures should be consistent with the integrated water management hierarchy.

The purpose of IWWMP is to compile a list of action plans and also to set goals and objectives in accordance with Integrated Water Resource Management (IWRM) Principles. It states that water and waste management decisions should be based on the following order of priority:

- Prevent or minimize the pollution or contamination of water used by implementing necessary management measures or strategies;
- Reuse or reclaim contaminated water in cases where complete pollution prevention was not possible;
- Treat water that cannot be reused or reclaimed
- Reuse treated water; and
- Discharge or disposal of treated water;

It can be deduced that IWWMP objectives can be categorized into the following two (2) broad themes:

a) pollution prevention and minimisation, and

b) reduction measures

3.8.1 Pollution prevention and minimisation measures

Compliance with IWRM Hierarchy requires pollution prevention and minimisation measures to be first options in the implementation plan. During the planning and design phase, consideration of recommendations from specialist studies needs to be accounted for during the site selection, technology evaluations and development and finalisation of the concept designs.

Examples for pollution prevention and minimisation can be identified according to the following framework:

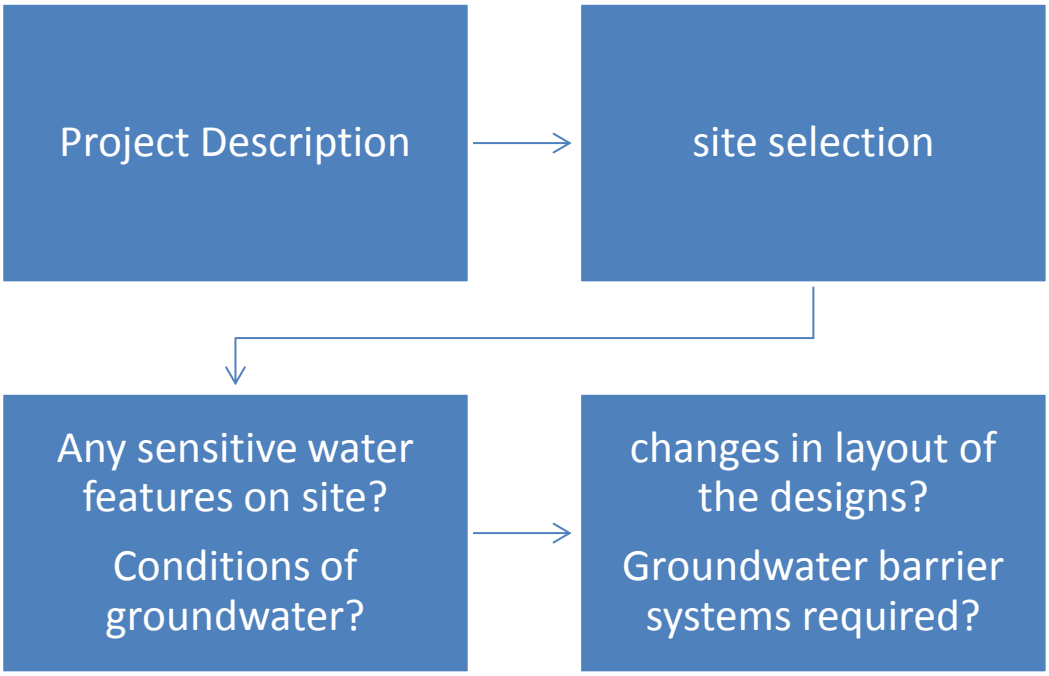


Figure 8: Prevention and minimisation measures framework

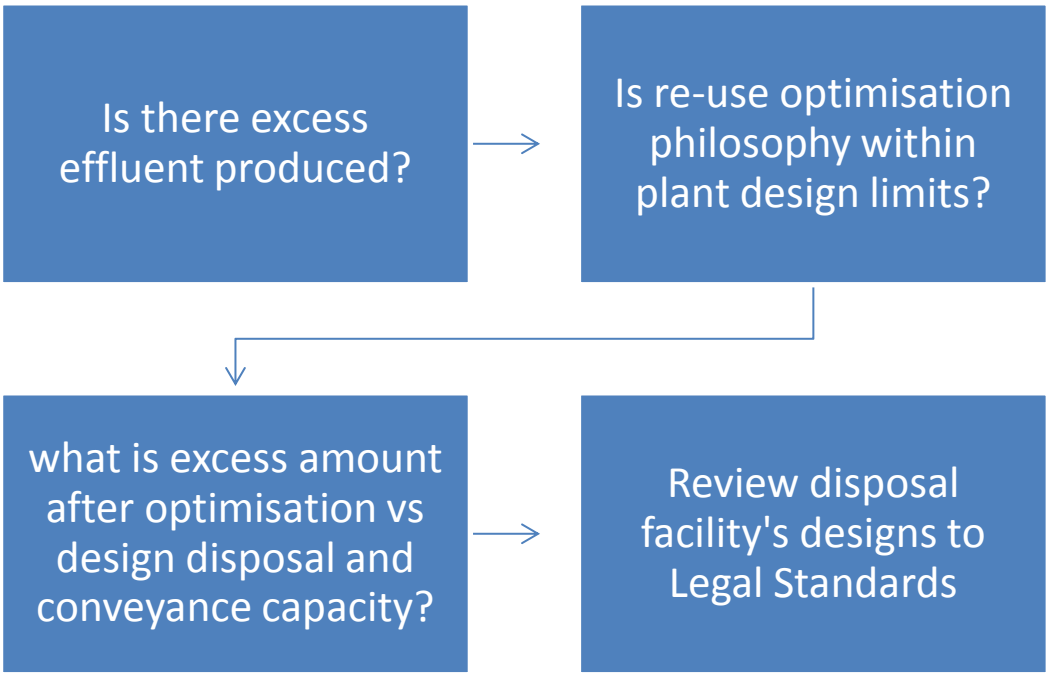


Figure 9: Reduction and disposal framework

3.8.2 Reduction measures

In case pollution prevention and minimisation measures cannot adequately mitigate the impacts or risks then reduction measures become the next consideration during the planning and design phase. These can be treatment, re-use and recycling effluent.

3.8.3 Disposal

Disposal and rehabilitation are the last options and may still require additional treatment of waste and other measures to contain and rehabilitate any residual impacts from the disposal facility.

3.8.4 Monitoring and reporting

Monitoring should be consistent with the objectives of the IWWMP. If key objective of the IWWMP is considered to be a framework to assist with pollution prevention and minimisation, then the objective of the monitoring program should be as follows:

- Pollution prevention of the water resources and
- Implementation of the actions required to prevent and minimize pollution.

Table 3-13 lists existing monitoring programs currently being implemented, objectives, key performance indicators and frequency.

Table 3-13: Types of monitoring program and objectives

Type of Monitoring	Objectives	Key Performance Indicator (KPI)	Frequency
Surface water, ground water and bio monitoring program	Assess impact of water uses on the water resource	Water quality objectives	Monthly, quarterly and seasonal
Water Use License Audits	Identify non-compliances with WUL conditions, track close-out of actions	Audit report's number of findings	Monthly, annually
Water Use Efficiency	Identify water losses, track close out of actions and report on water use performance	Water use performance target	Weekly, monthly and annually
Legal Contraventions	Identify pollution risks, close out actions and report legal contraventions	Number of legal contraventions	Daily

Legal contraventions and surface-groundwater monitoring programs only relates to the first objective which provides information on whether pollution exists or not. While Water use efficiency and Water Use License Audits to some extent the implementation of measures to prevent and minimise pollution.

3.9 OTHER INFORMATION REQUIREMENTS

3.9.1 Section 27 motivation

Section 27 motivation is also a requirement for the Water Use License Application. It is a list of criterion as per section 27 of the Act that the Authority needs to consider when making a decision on the WULA. One set of questions require the applicant to motivate on how the project will contribute to redress and socio-economic conditions of the community and the Country. These aspect of the information would not have been discussed anywhere in the preceding sections. Therefore, socio-economic impact assessment studies should be undertaken where information is not available to address this requirement.

3.9.2 Proposed Water Use License Conditions and Amendments

The purpose of this section is to motivate for practices that would not otherwise be allowed within the current requirements but can still achieve the same level of compliance under different circumstances in terms of time-frame, site conditions and technological specifications.

3.10 MONITORING AND REPORTING

Implementation of this document will be monitored as per SCOT guidelines.

4. AUTHORISATION

This document has been seen and accepted by:

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5. REVISIONS

Date	Rev.	Compiler	Remarks
November 2012	0.1	B Nyembe	Draft document for review created from GGM 0970
November 2012	1	T Chabedi	Final for Authorisation and Publication
September 2016	1.1	T Chabedi	The technical content of the document has not been

Date	Rev.	Compiler	Remarks
			changed. The only changes made to the document are the document revision date, the authorisation table, the signatories and the development team. The purpose of the update is to extend the validity of the document while the document is in the process of being reviewed.
September 2016	2	T Chabedi	Final Rev 2 for Authorisation and Publication
March 2018	2.1	T.R Chabedi	To align Eskom's business needs with new legislative requirements for purposes of achieving compliance to the water use license conditions.
March 2018	3	T.R Chabedi	Final Rev 3 for Authorisation and Publication

6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Felicia Sono
- Cornel Claassen

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- Eskom Water Care Group and Water Management Forum for their inputs to the document.