HYDROLOGICAL ASSESSMENT FOR THE MPONENG LOWER COMPARTMENT TAILINGS STORAGE FACILITY

VERSION 1

16 FEBRUARY 2026

PROJECT NO. EIM-017

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Hydrologic Consulting has been appointed by Environmental Impact Management Services (EIMS) to undertake a hydrological impact assessment for the proposed Harmony Gold Mining Company Limited (the applicant's) Mponeng Lower Compartment Tailings Storage Facility (hereafter referred to as Mponeng TSF). The TSF is located approximately 7km south-west of the town of Carletonville, in the Gauteng Province of South Africa and is part of the greater Mponeng Operation.

This hydrological assessment considers the potential hydrological (surface water) impacts related to the proposed commencement of deposition on the Mponeng TSF and associated pipeline infrastructure.

The assessment considers NEMA EIA regulations, 2014, Government Notice (GN) R 982 (as amended). Additional regulations in the form of Government Notice 704 (Government Gazette 20118 of June 1999 GN 704) have also been considered.

1.1 SCOPE OF WORK

The scope of work was achieved by undertaking the following:

- Baseline Assessment – sourcing of baseline climatic and hydrological data. This included the interrogation of rainfall data, site-specific design rainfall (depth/duration/frequency), evaporation, soils, and land use, as well as a regional and local hydrological assessment.
- Hydrological Impact Assessment – this was undertaken using a recognised risk assessment methodology developed to enable effective communication of the potential consequences or impacts of activities on the hydrological (surface water) environment; and
- A technical report detailing the achieved scope of work (this report).

The above scope of work is based on a desktop assessment of the site.

1.2 PROJECT DESCRIPTION

The following project description[1] outlines the proposed works.

The applicant owns and operates a number of Gold Mines and Plants in the West Wits region in the Gauteng Province. The Savuka Plant currently deposits tailings onto the Savuka 7a & 7b Tailings Storage Facilities (TSFs).

Savuka 7a & 7b TSFs are approaching their final and approved height, and the current planned Life of Mine (LOM) for the West Wits region exceed the available deposition capacity of these TSFs. Accordingly, the applicant is undertaking a feasibility assessment to recommence deposition on the Mponeng TSF Lower Compartment.

Mponeng Lower TSF is an existing TSF, however, the Mponeng Lower Compartment TSF is no longer in operation and is currently utilised as a Holding Dam, and a portion of it is used as an authorised Landfill Facility. To recommence deposition on the Mponeng TSF, from the Savuka Plant, slurry pipelines will need to be constructed from the Savuka Plant to the TSF. The proposed slurry and return water pipes extend from the south of Savuka Plant

[1] *1658_Project Background.pdf*

at starting point 26° 25' 24.95" S; 27° 23' 58.94" E, extending southwards, parallel to each other until reaching the northern extent of Mponeng TSF where they split. Thereafter, the slurry pipeline extends west before connecting to Mponeng TSF while the return water pipeline extends east then south around the TSF to the return water dam. The proposed alternative slurry and return water pipeline route extends to the east through Western Deep Levels then south along Mponeng Gold Mine before heading to the west where it connects to Mponeng TSF.

1.3 REGIONAL SETTING AND LAYOUT

The Mponeng TSF, Return Water Dam, and the Slurry and Return Water Pipelines (hereafter also referred to as the study area) are located at 26° 27' 17" S and 27° 24' 37" E. The regional setting of the site is illustrated in **Figure 1-1,** while the layout of the site is presented in **Figure 1-2**.

The Mponeng Tailings Storage Facility Project includes the following associated infrastructure:

- Tailings Storage Facility (Mponeng)
- Return Water Dam (RW Dam); and
- Slurry and Return Water Lines, including an alternative route option.

1.3.1 EXPERTISE OF PRIMARY AUTHOR AND DECLARATION OF INDEPENDENCE

Mr. Mark Bollaert is a consulting hydrologist with over 17 years of experience in the United Kingdom and South Africa. He holds a Master of Science (MSc) in Hydrology from the University of KwaZulu-Natal. Mark maintains numerous professional qualifications, including Chartered Scientist (CSci), Chartered Environmentalist (CEnv), and Chartered Water and Environmental Manager (CWEM) in the UK, as well as Professional Natural Scientist (Pr.Sci.Nat.) in Water Resources in South Africa.

Hydrologic Consulting and Mr. Mark Bollaert declare their independence regarding this project. Other than fair remuneration for the work undertaken, they hold no business, financial, or personal interest in the proposed activity or application, and there are no circumstances that could compromise their professional objectivity.

FIGURE 1-1: REGIONAL SETTING

FIGURE 1-2: LAYOUT

2 BASELINE ENVIRONMENT

Baseline information in this section includes discussions on the rainfall, evaporation, design event rainfall, soils, vegetation, and land cover, as well as site topography and regional and local catchment hydrology.

2.1 [i]RAINFALL

Various weather stations managed by both the South African Weather Services (SAWS) and the Department of Water and Sanitation (DWS) were considered in this project. These, together with their proximity to the site, can be seen in **Figure 2-1**.

Numerous SAWS and DWS stations are located near the site. Pegram (2016) provides a collation of SAWS and DWS data into monthly averages. **Table 2-1** presents the summary of the site-specific Pegram (2016) average monthly rainfall distribution, while **Figure 2-1** illustrates the rainfall variation in the region of the site.

TABLE 2-1: AVERAGE MONTHLY RAINFALL DISTRIBUTION (PEGRAM, 2016)

Month	Rainfall (mm)
Jan	111
Feb	90
Mar	83
Apr	44
May	19
Jun	8
Jul	6
Aug	8
Sep	21
Oct	59
Nov	91
Dec	101
Total	**640**

*Estimates were sourced for the centre of the site

2.2 1-DAY DESIGN RAINFALL DEPTHS

Design rainfall estimates for various recurrence intervals (RI) and storm durations were sourced from the Design Rainfall Estimation Software for South Africa (DRESSA), developed by the University of Natal (which has since been incorporated into the University of KwaZulu-Natal) in 2002 as part of a WRC project K5/1060 (Smithers and Schulze, 2002). This method uses a Regional L-Moment Algorithm (RLMA) in conjunction with a Scale Invariance approach to provide site-specific estimates of design rainfall (depth, duration and frequency), based on surrounding station records. WRC Report No. K5/1060 (WRC, 2002) provides more detail on the verification and validation of the method. **Table 2-2** presents the 24-hour storm depths for various recurrence intervals.

FIGURE 2-1: WEATHER STATIONS AND MEAN ANNUAL PRECIPITATION

TABLE 2-2: 24-HOUR STORM DEPTH

Recurrence Interval (Years)	Rainfall Depth (24-hour) (mm)
2	63.7
5	84.9
10	99.2
20	113
50	131.1
100	144.8
200	158.6

*Estimates were sourced for the centre of the site

2.3 EVAPORATION

Evaporation data was sourced from the South African Atlas of Climatology and Agrohydrology (Schulze and Lynch, 2006) in the form of A-Pan equivalent potential evaporation. The average monthly evaporation distribution is presented in **Table 2-3** and shows the site has an annual potential evaporation of 2,244mm.

TABLE 2-3: AVERAGE MONTHLY A-PAN EQUIVALENT EVAPORATION

Month	Evaporation(mm)
Jan	238
Feb	191
Mar	185
Apr	150
May	129
Jun	103
Jul	117
Aug	162
Sep	218
Oct	254
Nov	246
Dec	251
Total	**2,244**

*Estimates were sourced for the centre of the site

2.4 AVERAGE CLIMATE

The average climate for the site is presented in **Figure 2-2** using the outcome of the investigation into rainfall and evaporation for the site. The combination of rainfall (Pegram, 2016) and evaporation and temperature (Schulze and Lynch, 2006)[2] results in a temperate climate with dry winters and warm summers according to the Köppen-Geiger climate classification[3].

* South African Atlas of Climatology and Agrohydrology

[2] *Schulze and Lynch (2006) is the latest available dataset (Atlas, 2006) providing mean A-Pan Evaporation and Temperature data (1950-1999). The regional grids provide data that is not supplanted by newer remote sensed data.*

[3] http://stepsatest.csir.co.za/climate_koppen_geiger.html

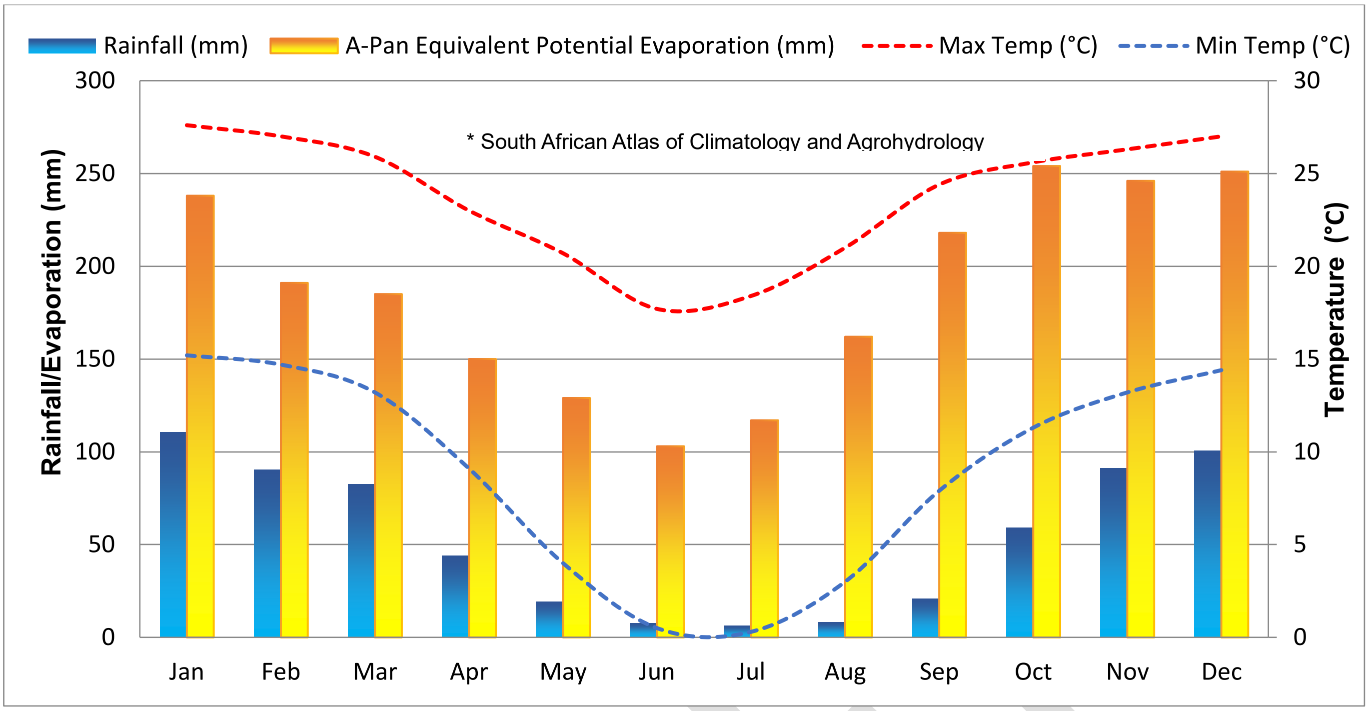

FIGURE 2-2: AVERAGE MONTHLY CLIMATE FOR THE SITE[4]

2.5 TERRAIN

Two datasets were used to assess the elevation of the site and its surrounds, namely:

1. A 30m COP30[5] DSM dataset; and
2. The National Geospatial Institutes (NGI's) 1:50,000 topographical map 20m contours.

The two elevation datasets utilised are illustrated in **Figure 2-3**.

The 30m DSM enabled a high-level understanding of the terrain of the site. Elevation on the site ranges from approximately 1,550m to 1,708m AMSL. The 20m NGI contours were used to illustrate the general 'lie of the land'.

Figure 2-3 also includes a calculation of slope with the site predominantly exhibiting slopes below 10%; however, the areas with existing TSFs are generally steeper, with some slopes falling between 10-30%.

[4] *Schulze and Lynch (2006) is the latest available dataset (Atlas, 2006) providing mean A-Pan Evaporation and Temperature data (1950-1999). The regional grids provide data that is not supplanted by newer remote sensed data.*

[5] *Copernicus Digital Elevation Model - Copernicus Contributing Missions Online*

FIGURE 2-3: TERRAIN AND HYDROLOGY

2.6 HYDROLOGY

Figure 2-3 also illustrates the hydrological setting of the site, while **Figure 2-1** presents the river network of the greater region. The site is positioned within quaternary catchment C23J with the proposed pipelines extending to quaternary catchment C23E.

The nearest River is the Elandsfonteinspruit River to the south-east of the site, however, this river is only labelled in the 1:500,000 river dataset for South Africa. The NGI's 1:50,000 topographical map data illustrates numerous non-perennial river systems to the north and south, both of which converge to the southeast of the site. The northern system feeds the Elandsfonteinspruit, enabling perennial flows (per the NGI's classification).

The northern and southern systems are associated with a vlei to the east and dams both north and south of the site. There are upstream furrows directing runoff from part of the greater Mponeng Operation (south of the Old North Complex TSF) and along the Mponeng TSF trenches draining to the non-perennial rivers to the west. The southern system is characterised by two larger dams, one of which is listed as the proposed return water dam for the Mponeng TSF.

All hydrological features have been presented according to the NGI's 1:50,000 topographical map data and this report does not intend to alter their classification.

This report also does not delineate or comment on the significance of any wetlands/vleis – consideration of this would require a wetland specialist. The NGI's 1:50,000 vleis are used for indicative purposes.

2.7 SOILS, VEGETATION, AND LAND-COVER

In considering the Soil Conservation Service for South Africa (SCS-SA) dataset of the site, soils are classified as being in hydrological soil group C (moderately high runoff potential). While the TSFs have covered over the natural soils, the TSF conditions are expected to tend towards high runoff potential.

The natural vegetation of the site is classified as Gauteng Shale Mountain Bushveld (according to SANBI, 2018). 'Mines and Quarries' is predominant over the site according to the Department of Forestry, Fisheries and the Environment (DFFE's) 2022 land-cover dataset. 'Grassland' and 'Waterbodies' make up secondary land-covers.

The distributions of the SCS soil types and natural vegetation are illustrated in **Figure 2-4** while **Figure 2-5** presents the land-cover about the site.

FIGURE 2-4: SOIL AND VEGETATION

FIGURE 2-5: LAND-COVER

3 APPLICABLE GUIDANCE

The guidance that informs the hydrological assessment outlined in this report includes the following:

- National Environmental Management Act (Act No. 107 of 1998) as amended, states that "Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring..."
- National Water Act (Act No. 36 of 1998) includes Section 21 water uses which require authorisation from the Department of Water and Sanitation (DWS).
- Department of Water and Sanitation Notice 509 of 2016 provides clarity on the regulated area of a watercourse;
- Government Notice 704 (Government Gazette 20118 of June 1999) provides regulations on the use of water for mining and related activities aimed at the protection of water resources;
- Department of Water and Sanitation (DWS) Best Practice Guideline G1 for Stormwater Management;
- Landcom Soils and Construction, Volume 1, 4th edition from 2004 (otherwise known as the Blue Book) has been used widely in the South African context in providing practical recommendations regarding the management of stormwater and associated erosion controls; and
- The South African Roads Agency Limited (SANRAL) 6th edition Drainage Manual (2013) provides some valuable insight into hydrological and hydraulic methods applicable to stormwater management and flooding.

3.1 NATIONAL WATER ACT

Definitions applicable to the identification of Section 21 water uses as defined by the National Water Act (Act No 36 of 1998) consist of:

- *"Watercourse"* including:
  - a river or spring;
  - a natural channel in which water flows regularly or intermittently; or
  - a wetland, lake or dam into which, or from which, water flows.
- *"Water resource"* – which includes a watercourse, surface water, estuary, or aquifer;
- "*Waste*" – which includes any solid material or material that is suspended, dissolved or transported in water (including sediment) and which is spilled or deposited on land or into a water resource in such volume, composition or manner as to cause, or to be reasonably likely to cause, the water resource to be polluted;

Section 21 water uses are not reviewed in this report, with EIMS undertaking to identify and authorise these.

3.2 DEPARTMENT OF WATER AND SANITATION NOTICE 4167 OF 2023

DWS Notice 4167 of 2023 "General Authorisation in Terms Of Section 39 of the National Water Act 36 of 1998 for Water Uses as defined in Section 21(c) Or Section 21(i)" includes the following:

- **Regulated area of a watercourse –** for section 21(c) or (i) of the Act water uses in terms of this Notice means:

(a) The outer edge of the 1 in 100-year flood line or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, dams and lakes;

(b) In the absence of a determined 1 in 100-year flood line or riparian area as contemplated in (a) above the area within 100m distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the National Water Act 36 of 1998);

(c) In respect of a wetland: a 500 m radius around the delineated boundary (extent) of any wetland (including pans);

Where the applicable Section 21 water uses per the above are as follows:

- ***Section 21 (c)* –** impeding or diverting the flow of water in a watercourse;
- ***Section 21 (i)* –** altering the bed, banks, course or characteristics of a watercourse.

3.3 GN 704

The Department of Water Affairs and Forestry (now the Department of Water and Sanitation) established GN 704 to provide regulations on the use of water for mining and related activities aimed at the protection of water resources.

3.3.1 IMPORTANT DEFINITIONS IN GN 704

- **Activity**: (a) any mining related process on the mine including the operation of washing plants, mineral processing facilities, mineral refineries and extraction plants, and (b) the operation and the use of mineral loading and off-loading zones, transport facilities and mineral storage yards, whether situated at the mine or not,
  - (i) in which any substance is stockpiled, stored, accumulated or transported for use in such process; or
  - (ii) out of which process any residue is derived, stored, stockpiled, accumulated, dumped, disposed of or transported;

- **Clean water system:** This includes any dam, other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of unpolluted water.

- **Dirty water system:** This includes any dam, other form of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste.

- **Dirty area:** This refers to any area at a mine or activity which causes, has caused or is likely to cause pollution of a water resource (i.e. polluted water).

3.3.2 APPLICABLE CONDITIONS IN GN 704

The principal conditions of GN 704 applicable to the site are:

Condition 4 – Restrictions on locality – No person in control of a mine or activity may:

(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

(b) except in relation to a matter contemplated in regulation 10 (i.e. Additional regulations relating to winning sand and alluvial minerals from watercourse or estuary), carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest;

(c) place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or

(d) use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood-line of any watercourse or estuary.

Condition 5 – Restrictions on use of material

No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource.

Condition 6 - Capacity requirements of clean and dirty water systems

Every person in control of a mine or activity must:

(a) confine any unpolluted water to a clean water system, away from any dirty area;

(b) design, construct, maintain and operate any clean water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;

(c) collect the water arising within any dirty area, including water seeping from mining operations. outcrops or any other activity, into a dirty water system;

(d) design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years; and

(e) design, construct, maintain and operate any dam or tailings dam that forms part of a dirty water system to have a minimum freeboard of 0.8 metres above full supply level, unless otherwise specified in terms of Chapter 12 of the Act.

(f) design, construct and maintain all water systems in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of the maximum flood with an average period of recurrence of once in 50 years.

Condition 7 – Protection of water resources

Every person in control of a mine or activity must take reasonable measures to:

(a) prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the Act;

(b) design, modify, locate, construct and maintain all water systems, including residue deposits, in any area so as to prevent the pollution of any water resource through the operation or use thereof and to restrict the possibility of damage to the riparian or in-stream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics;

(c) cause effective measures to be taken to minimise the flow of any surface water or floodwater into mine workings, opencast workings, other workings or subterranean caverns, through cracked or fissured formations, subsided ground, sinkholes, outcrop excavations, adits, entrances or any other openings;

(d) design, modify, construct, maintain and use any dam or any residue deposit or stockpile used for the disposal or storage of mineral tailings, slimes, ash or other hydraulic transported substances, so that the water or waste therein, or falling therein, will not result in the failure thereof or impair the stability thereof;

(e) prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources;

(f) ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time;

(g) at all times keep any water system free from any matter or obstruction which may affect the efficiency thereof; and

(h) cause all domestic waste, including wash-water, which cannot be disposed of in a municipal sewage system, to be disposed of in terms of an authorisation under the Act.

The Minister of the DWS may in writing, authorise an exemption to instances of GN 704 non-compliance.

4 IDENTIFIED SITE SENSITIVITIES

Sensitivity mapping was undertaken to identify sensitive features relating to the hydrological (surface water) environment within the study area. A 1000m buffer from the proposed Mponeng TSF, RW Dam, and the pipeline infrastructure (Slurry, Return Water, and Alternative Route) was used as the area under consideration.

The Department of Water Affairs and Forestry (now the Department of Water and Sanitation) established GN 704 to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. This includes the following condition:

Condition 4 – Restrictions on locality – No person in control of a mine or activity may:

(e) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

The 100m watercourse buffer is consequently one of the main guiding aspects in the assessment of site sensitivities given its relevance to GN 704, and its applicability to both flooding and the potential for contaminants to enter a watercourse (i.e. a wider river buffer is more likely to keep infrastructure/works outside of areas prone to regular or irregular flooding while enabling more time for containments within runoff, to settle out before entering the watercourse). A 100m watercourse buffer distance is, however, limited in its application since the proposed works/infrastructure will either fall within or outside this buffer distance, with no grading in site sensitivity possible. An expanded approach to the 100m river buffer was consequently adopted, utilising a variation in buffer distances modelled flooding and contour analysis.

Buffers have been derived from the 1:50,000 topographical map watercourse features. Open and closed reservoirs have been excluded on the basis that inflows are managed (and that there is no significant upslope catchment area of relevance). Watercourse buffers are technically applicable from the edge (top of bank) of the watercourse and not from the centreline (as in the case of rivers, drainage canals and furrows). The absence of a channel survey means that the river/furrow centreline has nevertheless been used to define buffers.

The following sensitivity bands were classified:

- Prevent Development
  - A 32m watercourse buffer (also applicable to NEMA activities) was used to define the functional area of the watercourse.
  - All development should be prevented in this area unless water-compatible or otherwise crossing over a watercourse (with flood risk factored in).
- High
  - A 100m buffer distance matches GN 704's and DWS Notice 4167 of 2023 prescribed buffer distance and is the minimum distance to a watercourse requiring motivation if works/infrastructure are going to be permitted, including a written exemption from the Minister of the Department of Water and Sanitation.

    - There is a strong disincentive towards development within this area.
- Medium
    - A 200m buffer distance was included as an intermediate buffer distance to the 100m buffer distance above and the 500m buffer distance below.
    - There is a medium disincentive towards development within this area.
- Low
    - A 500m buffer distance is a reasoned maximum distance from a watercourse, which in most instances will reflect the largest distance over which flooding would need to be considered.
    - DWS Notice 4167 of 2023 also outlines how a 500m buffer distance is applicable to wetlands (which includes pans and vleis as present in this study area). This report, however, does not focus on wetlands and only considers the 1:50,000 topographical map rivers.
    - There is a low disincentive towards development within this area.
- Remainder:
    - There is no sensitivity classification for the remainder of the site.

GN 704 restricts development within 100m of a watercourse (e.g. dam or river) and the above outline does not attempt to remove this restriction but is instead a high-level 'scaled' version of this buffer distance.

This classification only partly considers the 500m wetland buffer that applies. This wetland buffer is expected to be more comprehensively assessed as part of a wetland survey of the site and not the higher-level datasets present with the NGI's 1:50,000 topographical map dataset. No assessment of wetlands has been undertaken in this report.

Figure 4-1 presents the results of the identified site sensitivities relating to the surface water environment. As mentioned in **Section 2.6**, hydrological features have been defined according to the NGI's 1:50,000 topographical map data, and this report does not intend to alter their classification. However, the dam included in the Mponeng Study Area, south of the TSF, serves as the return water dam for the Lower Compartment TSF and has consequently been excluded from the sensitivity analysis.

FIGURE 4-1: SITE SENSITIVITIES (SURFACE WATER ENVIRONMENT)

5 HYDROLOGICAL IMPACTS AND MITIGATION MEASURES

An impact is any change (positive or negative) to a resource or receptor brought about by the presence of the project component or the execution of a project-related activity.

The project's potential impacts have been evaluated using a recognised risk assessment methodology developed to ensure communication of the potential consequences or impacts of activities on the hydrological (surface water) environment as set out in the National Environmental Management Act (NEMA). A quantitative approach was taken in determining environmental significance since this enables a cross-disciplinary assessment of impact whereby the interpretation of impact significance is the same (i.e., a high impact on the surface water environment has the same interpretation as a high impact on ecology).

5.1 METHOD OF ASSESSING IMPACTS

The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relating this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF), which is applied to the ER to determine the overall significance (S).

5.1.1 DETERMINATION OF ENVIRONMENTAL RISK

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER).

The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{E + D + M + R}{4} \times N$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table 5-1**.

TABLE 5-1: CRITERIA FOR DETERMINING IMPACT CONSEQUENCE

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)

	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined, the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per **Table 5-2**.

TABLE 5-2: PROBABILITY SCORING

Probability Score	Description
1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
3	Medium probability (the impact may occur; >50% and <75%),
4	High probability (it is most likely that the impact will occur- > 75% probability), or
5	Definite (the impact will occur),

The result is a qualitative representation of the relative ER associated with the impact. ER is therefore calculated as follows:

$$ER = C \ x \ P$$

TABLE 5-3: DETERMINATION OF ENVIRONMENTAL RISK

Consequence		Probability 1	Probability 2	Probability 3	Probability 4	Probability 5
	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Probability				

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in **Table 5-4**.

TABLE 5-4: SIGNIFICANCE CLASSES

Environmental Risk Score	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9 & <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post-implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

5.1.2 IMPACT PRIORITISATION

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

TABLE 5-5: CRITERIA FOR DETERMINING PRIORITISATION

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 5-5. The impact priority is therefore determined as follows:

$$Priority = CI + LR$$

The result is a priority score which ranges from 2 to 6 and a consequent PF ranging from 1 to 1.5 (Refer to **Table 5-6**).

TABLE 5-6: DETERMINATION OF PRIORITISATION FACTOR

Priority	Prioritisation Factor
2	1
3	1.125
4	1.25
5	1.375
6	1.5

To determine the final impact significance, the PF is multiplied by the ER of the post-mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a factor of 0.5, if all the priority attributes are high (i.e. if an impact comes out with a high medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

TABLE 5-7: FINAL ENVIRONMENTAL SIGNIFICANCE RATING

Rating	Description
≤ -17	High negative (i.e., where the impact must have an influence on the decision process to develop in the area).
> -17 ≤ -9	Medium negative (i.e., where the impact could influence the decision to develop in the area).
> -9 < 0	Low negative (i.e., where this impact would not have a direct influence on the decision to develop in the area).
0	No impact
>0 <9	Low positive (i.e., where this impact would not have a direct influence on the decision to develop in the area).
≥ 9 < 17	Medium positive (i.e., where the impact could influence the decision to develop in the area).
≥ 17	High positive (i.e., where the impact must have an influence on the decision process to develop in the area).

5.2 PROJECT PHASES

Savuka 7a & 7b TSFs are approaching their final and approved height, and the current planned Life of Mine (LOM) for the West Wits region exceeds the available deposition capacity of these TSFs. Accordingly, the applicant is undertaking a feasibility assessment to recommence deposition on the Mponeng TSF Lower Compartment.

The addition of standard tailings pipeline infrastructure (Slurry and Return Water Lines) are proposed as part of the recommencement of deposition.

There is one proposed alternative relative to this report (an alternative pipeline route).

This impact assessment has been developed on the understanding that the project comprises the following phases:

- Construction – surface infrastructure will be built on land cleared for the purpose of the return water and slurry lines; however, the TSF is already in existence.
- Operation – TSF and deposition line operation will commence.
- Decommissioning – all TSF operations will cease with certain surface infrastructure removed; and
- Rehab/Closure – disturbed surface areas will undergo rehabilitation.

5.2.1 ALTERNATIVES

With regard to the proposed return water and slurry lines, one alternative is present for a section of the line:

- Alternative 1 – Pipelines from Savuka east through Western Deep Levels then south along Mponeng Gold Mine before heading to the west where it connects to Mponeng TSF.

With regard to this study, the alternative, **Figure 4-1** illustrates how there is a greater number of rivers crossed while the greater length of the pipeline results in greater intersection within different areas of sensitivity.

5.3 IDENTIFIED SURFACE WATER IMPACT

5.3.1 EROSION OF SOILS

Eroded soils have the potential to cause sedimentation in downstream watercourses. The construction of infrastructure will lead to new areas being disturbed, resulting in the potential for soil erosion to occur during times of rainfall or through persistent streamflow, while the decommissioning of this infrastructure will result in the same. If not mitigated, erosion could continue during the operational phase, although it is expected that soils would settle to a degree, reducing the potential volume of erosion for any given rainfall event. The rehab/closure phase would have a similar risk of erosion to the construction phase.

The recommencement of deposition to the lower TSF compartment and its associated RW dam will limit the potential for eroded soils or sediment to enter the environment.

Potential erosion is exacerbated by the moderately high runoff potential of soils (see **Section 2.7**), which would cause a higher proportion of rainfall to be converted into runoff, thereby increasing the runoff's potential erosivity. The limited surface area of the deposition line (consolidated area to be disturbed) will limit the overall erosion of soils from the deposition line during all project phases.

Disturbed areas should consequently be stabilised, with erosion control methods used where stabilisation is not possible. Rehabilitation of the site should include topsoil replacement and revegetation of disturbed areas. River channels, furrows and trenches should not have any infrastructure placed within them unless essential. Consideration should be given to the enhanced erosion protection in this instance.

In considering the pipeline options, the resulting impact scoring shows no preference for either; however, the shorter (western) pipeline route would tend to be more favourable, given its reduced length and lower incidence of watercourse proximity.

TABLE 5-8: EROSION OF SOILS (CONSTRUCTION, DECOMMISSIONING & REHABILITATION/CLOSURE PHASES)

Impact Name	Erosion of Soils				
Phase	Construction, Decommissioning & Rehabilitation/Closure				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	2	1
Extent	3	1	Reversibility	2	2
Duration	3	1	Probability	4	3
Environmental Risk (Pre-mitigation)					-10.00
Mitigation Measures					

The mitigation below is expected to already be part of the existing TSFs management and also applies to the proposed pipeline construction.

- *Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).*
- *Monitor the TSFs to ensure areas of potential erosion are identified and managed appropriately.*
- *Rehabilitation should include topsoil replacement, re-vegetation, and maintenance/aftercare for disturbed areas, insofar as it should be developed for disturbed areas.*
- *The disturbed footprint should be minimised as far as practically possible.*
- *Rehabilitation should include topsoil replacement, re-vegetation, and maintenance/aftercare for disturbed areas, insofar as it should be developed for disturbed areas.*
- *Clearing of vegetation and associated excavation should be kept to a minimum, particularly in areas where soils are unstable*
- *All disturbed areas must be rehabilitated (as soon as practically possible) to represent the previous undisturbed environment (soil, land-cover, slope) to limit the impact on receiving water resources (by limiting soil erosion).*
- *Disturbed areas or areas rehabilitated with soils should be stabilised as soon as possible using plants (e.g. grass) or other mechanical methods (e.g. profiling or erosion control blankets).*
- *Where erosion is nevertheless likely to occur, it is recommended to use settling facilities or silt fences.*

• *Construction should, where possible, be scheduled to take place during the dry season when rainfall and associated erosion potential is at its lowest. For longer construction periods of more than six months, construction should be scheduled such that exposure of soils (before the addition of hardstanding or rehabilitation) occurs mostly within the dry season as far as possible.* • *Concurrent rehabilitation of the TSFs should ideally occur during the life of the TSFs. This would likely include cladding of TSF's side slopes and subsequent revegetation with the final TSF's rehabilitation resulting in a fully vegetated site.* • *Additional guidance on erosion control is available in: Landcom Soils and Construction, Volume 1, 4th edition from 2004 (otherwise known as the Blue Book).*	
Environmental Risk (Post-mitigation)	-3.75
Degree of confidence in impact prediction:	Medium
Impact Prioritisation	
Cumulative Impacts	2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	1
Low: Where the impact is unlikely to result in irreplaceable loss of resources.	
Prioritisation Factor	1.125
Final Significance	-4.219

TABLE 5-9: EROSION OF SOILS (OPERATION PHASE)

Impact Name	**Erosion of Soils**				
Phase	Operation				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	2	1
Extent	3	1	Reversibility	2	2
Duration	3	1	Probability	3	2
Environmental Risk (Pre-mitigation)					-7.50
Mitigation Measures					
The mitigation below is expected to already be part of the existing TSFs management and also applies to the proposed pipeline construction. • *Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).* • *Monitor the TSFs and pipelines to ensure areas of potential erosion are identified and managed appropriately.* • *The disturbed footprint should be minimised as far as practically possible.* • *Concurrent rehabilitation of the TSFs should ideally occur during the life of the TSFs. This would likely include cladding of TSF's side slopes and subsequent revegetation with the final TSF's rehabilitation resulting in a fully vegetated site.* • *Additional guidance on erosion control is available in: Landcom Soils and Construction, Volume 1, 4th edition from 2004 (otherwise known as the Blue Book).*					
Environmental Risk (Post-mitigation)					-2.5
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
Low: Where the impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.125
Final Significance					-2.813

5.3.2 POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT

Potential pollutants are already limited by the design of the project, given the containing nature of the existing TSFs. Uncontrolled release of tailings or contaminated return water is possible and would be considered a residual risk (post-mitigation). A TSF failure, while a highly unlikely event, has the potential to cause severe pollution of the downstream environment, while poor operation of the TSF and RWD could see an unplanned spill from the RW Dam. Adequate engineering and operation of the TSF would mitigate these two potential impacts.

Operation of earthmoving machinery or maintenance of vehicles on-site during construction, operation, decommissioning, and rehab/closure (including the possible storage or handling of hydrocarbons) poses a potential source of hydrocarbon contamination regarding the surface water environment. Vehicles and machinery should consequently be well maintained and stored/parked with drip trays and with an emergency response strategy for unforeseen hydrocarbon spills. With regards to the TSF, potential pollutants are already limited by the design of the project, given the containment nature of the TSF.

A stormwater management plan per GN 704 requirements is expected to have already been implemented for the TSF; however, it will require revalidation for the proposed recommenced use of the Mponeng Lower Compartment. A stormwater management plan is likely unnecessary for the pipelines on the basis that they are sealed and designed not to spill (and therefore shouldn't spill more than once every 50 years). A line rupture or leak is nevertheless a possibility, and the pipeline route should consequently be positioned within managed dirty areas where possible (those currently managed or anticipated to be managed as part of Harmony's compliance with GN 704). Uncontrolled release of tailings is possible and would be considered a residual risk (post-mitigation). Pipeline monitoring and maintenance will be an essential part of mitigation.

In considering the pipeline options, the resulting impact scoring shows no preference for either; however, the shorter (western) pipeline route would tend to be more favourable, given its reduced length and lower incidence of watercourse proximity.

Important. It should also be noted that the potentially severe impact of a TSF failure is not adequately conveyed by the impact table below since the probability is low, resulting in the impact appearing less significant than may be warranted.

TABLE 5- 10: POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT (CONSTRUCTION PHASE)

Impact Name	Pollutants Entering the Surface Water Environment				
Phase	Construction				
Impact Name					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	3	3
Extent	3	3	Reversibility	3	3
Duration	2	2	Probability	3	1
Environmental Risk (Pre-mitigation)					-8.25
Mitigation Measures					
The mitigation below is expected to already be part of the existing TSFs management and also applies to the proposed pipeline construction. • *Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).* • *Monitor the TSFs to identify any potential failures/slumps.* • *Design and construct the pipeline using sound engineering to avoid pollutants entering the surface water sources.* • *Keep activity within the managed dirty water footprint where possible.* • *Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited.* • *Use drip trays for stationary vehicles or otherwise park over areas suited to their storage (e.g. with an oil interceptor)* • *Designate a single location for refuelling and maintenance where possible.* • *Keep a spill kit on site to deal with any hydrocarbon leaks.* • *Remove soil from the site that has been contaminated by hydrocarbon spillage.* • *Undertake surface water monitoring to enable change detection related to contaminants originating from the site.*					
Environmental Risk (Post-mitigation)					-2.75
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Cumulative Impacts					3
High: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change					
Degree of potential irreplaceable loss of resources					1
Low: Where the impact is unlikely to result in irreplaceable loss of resources.					

Prioritisation Factor	1.25
Final Significance	-3.438

TABLE 5-11: POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT (OPERATION & DECOMMISSIONING PHASES)-

Impact Name	**Pollutants Entering the Surface Water Environment**				
Phase	Operation & Decommissioning				
Impact Name					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	5	5
Extent	5	5	Reversibility	5	5
Duration	3	3	Probability	3	1
Environmental Risk (Pre-mitigation)					-13.50
Mitigation Measures					
The mitigation below is expected to already be part of the existing TSFs management and also applies to the proposed pipeline construction. • *Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).* • *Develop the TSF (recommissioning procedure) using sound engineering to limit the likelihood of a failure.* • *Monitor the TSFs and pipelines to identify any potential failures/slumps.* • *Maintain and operate the TSFs/RWD to limit the potential for overfilling of the RWD that leads to a spill.* • *Keep activity within the managed dirty water footprint where possible.* • *Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited.* • *Use drip trays for stationary vehicles or otherwise park over areas suited to their storage (e.g. with an oil interceptor)* • *Designate a single location for refuelling and maintenance where possible.* • *Keep a spill kit on site to deal with any hydrocarbon leaks.* • *Remove soil from the site that has been contaminated by hydrocarbon spillage.* • *Undertake surface water monitoring to enable change detection related to contaminants originating from the site.*					
Environmental Risk (Post-mitigation)					-4.5
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Cumulative Impacts					3
High: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change					
Degree of potential irreplaceable loss of resources					1
Low: Where the impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.25
Final Significance					-5.625

TABLE 5-1212: POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT (REHABILITATION/CLOSURE PHASE)

Impact Name	**Pollutants Entering the Surface Water Environment**				
Phase	Rehabilitation/Closure				
Impact Name					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	3	3
Extent	5	5	Reversibility	3	3
Duration	3	3	Probability	4	1
Environmental Risk (Pre-mitigation)					-14.00
Mitigation Measures					
The mitigation below is expected to already be part of the existing TSFs management and also applies to the proposed pipeline construction. • *Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).* • *Monitor the TSFs and pipelines to identify any potential failures/slumps.* • *Keep activity within the managed dirty water footprint where possible.* • *Use drip trays for stationary vehicles or otherwise park over areas suited to their storage (e.g., with an oil interceptor)* • *Designate a single location for refuelling and maintenance where possible.* • *Keep a spill kit on site to deal with any hydrocarbon leaks.* • *Remove soil from the site that has been contaminated by hydrocarbon spillage.* • *Undertake surface water monitoring to enable change detection related to contaminants originating from the site.*					

Environmental Risk (Post-mitigation)	-3.5
Degree of confidence in impact prediction:	Medium
Impact Prioritisation	
Cumulative Impacts	3
High: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change	
Degree of potential irreplaceable loss of resources	3
High: Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1.5
Final Significance	-5.25

5.3.3 INCREASE IN RUNOFF

The Mponeng TSF is a decommissioned TSF that was presumably already managed from a stormwater perspective. It is assumed that the TSF had a containment philosophy in place, as enabled by the self-containing TSF basin, toe paddocks, and RW Dam, with overall runoff from the TSF site decreased to near zero (before any treatment and discharge). As such, the recommencement of the Mponeng TSF will result in a negligible change in runoff given a similar footprint and containment philosophy. Changes in runoff are consequently due to the construction of the slurry and return water lines alone (based on the brownfield status of the TSF).

The proposed construction of the slurry and return water lines (plinths) will increase impermeable hardstanding, although the impermeable area is negligible compared to the greater Mponeng operation. **Figure 5-1** illustrates the area of hardstanding (plinths) associated with a pipeline.

The potential use of a gravel or dirt-based access road is expected, in which case its impact will relate more to compaction. There is consequently a limited area of hardstanding that would increase runoff, with changes in runoff potentially immeasurable. This minimal impact informs the recommended mitigation, which has been kept basic (in association with the limited impact). The minor nature of the impact and recommended mitigation means that there is little difference between the impact before and after mitigation.

FIGURE 5-1: EXAMPLE OF PIPELINE ON CONCRETE PLINTHS WITH ADJACENT ACCESS ROAD

Impermeable areas would relate to the construction, operational, and decommissioning phases and not the rehab/closure phase. Compaction resulting from the movement of machinery and use of laydown areas may be noticeable at the activity level; however, it is not at the site level due to the small area of work. Reducing the duration and area over which machinery operates, or over which laydown areas are utilised, would reduce the influence of compaction. Compaction would primarily relate to the construction, decommissioning, and rehab/closure phases.

In considering the pipeline options, the resulting impact scoring shows no preference for either; however, the shorter (western) pipeline route would tend to be more favourable, given its reduced length and lower incidence of watercourse proximity.

TABLE 5-13: INCREASE IN RUNOFF (CONSTRUCTION, OPERATION, & DECOMMISSIONING PHASES)

Impact Name	Increase in Runoff				
Phase	Construction, Operation, & Decommissioning				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	1	1
Extent	1	1	Reversibility	2	2
Duration	4	4	Probability	5	5
Environmental Risk (Pre-mitigation)					-10.0
Mitigation Measures					
The mitigation below is expected to already be part of the existing TSFs management and also applies to the proposed pipeline construction. • *Limiting the time and area over which machinery operates will limit the compaction of soils on the site.* • *Divert clean water run-on away from the TSF.*					
Environmental Risk (Post-mitigation)					-10.0
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Cumulative Impacts					1
Low: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
Low: Where the impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1
Final Significance					-10.0

TABLE 5-14: INCREASE IN RUNOFF (REHABILITATION/CLOSURE PHASE)

Impact Name	Increase in Runoff				
Phase	Rehabilitation/Closure				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	1	1
Extent	1	1	Reversibility	2	2
Duration	1	1	Probability	5	5
Environmental Risk (Pre-mitigation)					-6.25
Mitigation Measures					
The mitigation below is expected to already be part of the existing TSFs management and also applies to the proposed pipeline construction. • *Limiting the time and area over which machinery operates will limit the compaction of soils on the site.* • *Divert clean water run-on away from the TSF.*					
Environmental Risk (Post-mitigation)					-6.25
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Cumulative Impacts					1
Low: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
High: Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.25

Final Significance	-7.8125

5.3.4 FLOOD RISK

Flood risk is both an impact on the proposed TSF, RW Dam, or tailings pipelines (flooding originating from the surrounding environment) and on the environment (flooding originating from the TSF or RW Dam) and includes:

- A TSF or RW Dam failure resulting in downstream flooding (flooding originating from the TSF),
- Flooding arising from either the rivers, furrows or trenches intersecting the pipelines or the river system north or south-east of the TSF (flooding originating beyond the TSF); and
- Surface water run-on towards the TSF, RW Dam, or pipelines (flooding originating beyond the TSF).

This risk is expected to be present during the construction, operational, decommissioning, and rehab/closure phases (flooding originating from the environment) and during the operational, decommissioning, and rehab/closure phases (flooding originating from the TSF/RW Dam). The proposed construction of the slurry and return water lines has minimal influence on the existing flood risk to the TSF; however, recommenced use of the TSF may increase the flood risk of the TSF due to the increase in the TSF volume.

Section 4 presents a site sensitivity grading that can inform potential flood risk; however, this is qualitative only. A quantified assessment of flooding would need to consider the actual fluvial flood risk to the TSF and pipelines (from the adjacent river systems). This understanding of flooding is important given the pipelines which cross rivers or come close to them (within 100m) and the position of the Lower TSF Compartments and associated RW Dam.

At its closest, the RW Dam is offset approximately 100m from the dam to the south-east, while the TSF is 168m away from the dam. A TSF (given its high risk with regard to failure) warrants the consideration of the most significant of flood events, including the probable maximum flood (PMF), which may be sufficiently large to overtop the RW dam or reach the base of the Lower TSF Compartment. TSF flood risk may have previously been assessed during the original TSF's development and should be assessed if not previously done. The influence of climate change may also warrant re-assessment of any previous flood modelling for the TSF.

TSF failure (while highly unlikely to occur) has both flooding and pollutant implications (discussed in **Section 5.3.2**).

Pre-mitigation and post-mitigation scoring are equivalent due to the historical operation of the TSFs and the limited impact the construction of the slurry and return water lines will have on the surface water environment (compared to the current).

In considering the pipeline options, the resulting impact scoring shows no preference for either; however, the shorter (western) pipeline route would tend to be more favourable, given its reduced length and lower incidence of watercourse proximity.

Important. It should be noted that the potentially severe impact of flood risk is not adequately conveyed by the impact table below since the probability of extreme flooding is low, resulting in the impact appearing less significant than may be warranted.

TABLE 5-15: RIVER AND SURFACE WATER FLOOD RISK (CONSTRUCTION & REHABILITATION/CLOSURE PHASES)

Impact Name	Flood Risk				
Phase	Construction & Rehabilitation/Closure				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	4	4
Extent	3	3	Reversibility	4	4
Duration	1	1	Probability	1	1
Environmental Risk (Pre-mitigation)					-3.00
Mitigation Measures					
The mitigation below is expected to already be part of the existing TSFs management and also applies to the proposed pipeline construction. • *Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).* • *Ensure that flood protection of the TSF, pipelines, and Return Water Dam is sufficient to manage flood risk from both adjacent river systems (north and south) and stormwater run-on.* • *Works should ideally not take place, nor infrastructure placed within 100m of any defined watercourse or within the 1:100-year flood-line given the applicability of GN 704. The linear nature of the deposition line means that some watercourse crossings, proximity to a watercourse, or intersection with a flood line are expected.* • *The probable maximum flood (PMF) should be considered with regards to the safety of the TSF.* • *Pipelines are to be installed above-ground on pre-cast concrete plinths. These plinths should make adequate allowance for flooding, whether from a river, drainage canal, furrow or from surface water (runoff).* • *Develop the pipelines using sound engineering to limit the likelihood of a failure.* • *Monitor the TSFs and pipelines to identify any potential failures/slumps.*					
Environmental Risk (Post-mitigation)					-3.00
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Cumulative Impacts					3
High: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1.375
Final Significance					-4.125

TABLE 5-16: RIVER AND SURFACE WATER FLOOD RISK (OPERATION & DECOMMISSION PHASES)

Impact Name	Flood Risk				
Phase	Operation & Decommission				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	5	5
Extent	4	4	Reversibility	5	5
Duration	1	1	Probability	1	1
Environmental Risk (Pre-mitigation)					-3.75
Mitigation Measures					
The below mitigation is expected to already be part of the existing TSFs management. • *Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).* • *Ensure that flood protection of the TSF, pipelines, and Return Water Dam is sufficient to manage flood risk from both adjacent river systems (north and south) and stormwater run-on.* • *Monitor the TSFs and pipelines to identify any potential failures/slumps.*					
Environmental Risk (Post-mitigation)					-3.75
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Cumulative Impacts					3
High: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
High: Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).					

Prioritisation Factor	1.5
Final Significance	-5.625

5.4 ADDITIONAL CONSIDERATIONS

Flooding and pollutants entering the surface water environment are the two primary impacts indicated by the impact assessment. Both impacts are poorly represented in the impact assessment due to their probability of occurrence (improbable) with regard to a failure in the TSF, RW Dam, or pipelines.

6 SURFACE WATER MONITORING

Regular surface water quality monitoring is required to enable change detection resulting from the potential contamination of surface water by any deposition line leaks. Surface water monitoring points presently active over the greater Harmony Operation have been provided and are presented in **Figure 6-1**.

Since a surface water monitoring plan is already underway with a wide coverage of monitoring points, there is a limited need for additional monitoring points. When considering the 2023 Integrated Waste Water Management Plan (IWWMP), the only clear absence of monitoring is to the north of Savuka (Plant). A single monitoring point is consequently recommended to capture the influence of the proposed pipeline on water quality.

The position of the TSF and associated pipeline within the greater Harmony Operation warrants a more comprehensive assessment of surface water monitoring points than based on this project alone.

6.1 MONITORING PROGRAMME

Potential contaminants of concern that need to be monitored are expected to have already been identified based on the historical quarterly surface water quality monitoring that has been undertaken. The understanding of the mine's processes and the associated contaminants that might be released in the event of a failure in an aspect of the TSF, RW Dam or slurry and return water pipes lines is likewise expected to be clearly understood, with monitoring reflecting this.

Quarterly monitoring reports should be produced to differentiate seasonal variations and general trends due to the mining activities, with a comparison of water samples to standards and guidelines set by the Department of Water and Sanitation (DWS), and an analysis of parameters over time so that trends can be established.

The recommended additional monitoring point is illustrated in **Figure 6-1** and is presented in **Table 6-1**.

TABLE 6-1: ADDITIONAL MONITORING POINT RECOMMENDED

Monitoring Point	Coordinate
PSW01	26° 24' 42" S, 27° 24' 20" E

FIGURE 6-1: SURFACE WATER MONITORING

7 CONCLUSION AND RECOMMENDATIONS

Savuka 7a & 7b TSFs are approaching their final and approved height, and the current planned Life of Mine (LOM) for the West Wits region exceeds the available deposition capacity of these TSFs. Accordingly, the applicant is undertaking a feasibility assessment to recommence the deposition at Mponeng TSF Lower Compartment.

The slurry and return water pipelines are the only new infrastructure compared to the existing Mponeng TSF Lower Compartment. A single alternative has been proposed in the form of the pipeline route extending to the east.

Baseline information, including rainfall, evaporation, design event rainfall, soils, vegetation, and land-cover, as well as site terrain, flooding, and regional and local catchment hydrology, has been considered for the study area.

Applicable Guidance

The primary guidance applicable to this assessment is as follows:

- National Environmental Management Act (Act No. 107 of 1998) as amended, states that "Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring…";
- National Water Act (Act No. 36 of 1998) includes Section 21 water uses which require authorisation from the Department of Water and Sanitation (DWS);
- Department of Water and Sanitation Notice 509 of 2016 provides clarity on the regulated area of a watercourse; and
- Government Notice 704 (Government Gazette 20118 of June 1999) provides regulations on the use of water for mining and related activities aimed at the protection of water resources.

Site Sensitivities

Figure 4-1 presents the results of the identified site sensitivities as they relate to the surface water environment. This figure illustrates that there are parts of the TSF that are within sensitive areas; however, the TSF is already in existence. The pipelines are noted as intersecting many different sensitivity classifications, with the alternative pipeline crossing more rivers and a greater length of sensitive classifications than the primary pipeline route.

Identified Impacts

Flooding and pollutants entering the surface water environment are the two primary impacts to this project, whether or not indicated by the impact assessment. Both impacts are poorly represented in the impact assessment due to their probability of occurrence (improbable). In the case of flooding, there is flooding originating beyond the TSFs and flooding originating from the TSFs (due to a TSF failure). The latter presents the most significant risk to this study (that of flood risk and pollutants entering the surface water environment). A secondary pollutant risk is poor management of the TSFs (and by association the RWD) or pipelines, resulting in a spill.

The results of flood modelling should ideally be considered in the development of the pipelines and should undoubtedly be considered with regard to adequate flood protection of the Lower TSF Compartment and associated RW Dam.

In considering the pipeline options, the resulting impact scoring shows no preference for either; however, the shorter (western) pipeline route would tend to be more favourable, given its reduced length and lower incidence of watercourse proximity.

Surface Water Monitoring

Regular surface water quality monitoring is required to enable change detection, concerning the potential contamination of surface water by any deposition line leaks. Surface water monitoring points presently active over the greater Harmony Operation have been provided and are presented in **Figure 6-1**. A surface water monitoring plan is already underway with a wide coverage of monitoring points, with only one additional monitoring point proposed. The position of the TSF and associated pipeline within the greater Harmony Operation warrants a more comprehensive assessment of surface water monitoring points than based on this project alone.

Authorisation

The proposed recommencement of deposition at the Mponeng TSF Lower Compartment can be authorised with regard to the hydrological (surface water) environment, inclusive of the recommended mitigation measures presented in **Section 5**.

This should include an assessment of flooding, particularly with regard to the adequate offset of the pipeline above river crossings and in relation to adequate flood protection of the TSF and RW Dam. A review of Mponeng's surface water monitoring plan will also be required to ensure that the TSF and pipeline are adequately considered (as it relates to monitoring positions).

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