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SURFACE WATER REPORT FOR EVEREST NORTH MINE SITE

AQUARIUS PLATINUM LIMITED

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Report Title: **Surface Water Report for Everest North Mine Site**

Project Number: **SYL1256**

Name	**Responsibility**	**Signature**	**Date**
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EXECUTIVE SUMMARY

Aquarius Platinum Limited applied for the right to mine platinum on the farm Vygenhoek near Lydenburg in the Thaba Chweu Local Municipality. In accordance with the relevant legislation, the Environmental and Social Impact Assessment of the project has to be conducted. Aquarius Platinum Limited has contracted Digby Wells Environmental (Digby Wells) as an independent consultant to undertake the impact assessment.

The proposed mine will use both opencast and underground mining methods to mine platinum. There will be an establishment of a waste rock site and topsoil stockpile area and an upgrade of the existing mineral processing plant.

The affected catchment falls within the Groot Dwars River Catchment of the Olifants Water Management Area (WMA 01) and is located within the quaternary catchment B41G. The estimated peak flood discharge that could impact on the opencast mining area footprint for a 1: 50 year flood event is 189 m^3/s.

Surface water sampling was conducted on five sites. The hydrochemical data indicated that the water from all sampling points along tributary to the Groot Dwars had Iron (Fe) concentration of Class II level in terms of the South African National standard (SANS) 241: 2011 drinking water quality standards. This was attributed to the geological nature of the environment as the rest of the water quality components were within Class I. These results were also consistent when compared against the World Health Organization (WHO) guidelines for drinking water (2011).

An assessment of the surface water quality and quantity impacts was conducted utilising the Digby Wells developed method. The most significant impacts identified include:

- Surface water quality impacts that include potential water quality deterioration emanating from possible hazardous substances, hydrocarbons and PCD material spillages. Siltation of rivers as well as extensive dust deposition into streams could also contribute to water quality deterioration; and
- Surface water quantity impacts that result from the separation of dirty and clean water. This reduces the runoff from the catchment within the mining area that reports to the rest of the catchment.

The following mitigation measures are recommended to minimise the impacts:

- Clean and dirty water/ area separation and minimization of the dirty area to minimize the volume of runoff lost to the catchment;
- Dust suppression to minimise the dust created that could be deposited on the surface water resources and/ or drainage lines with potential water quality deterioration impacts;
- Vegetation application on the topsoil berms to prevent soil erosion and subsequent siltation of surface water resources;

- Use of monitoring as an early detection tool, implementation of mitigation measures where impacts are detected and implementing measures to ensure that water quality and quantity impacts are prevented from occurring in future; and
- Implementation of on-going rehabilitation coupled with monitoring and maintenance to ensure that the planted vegetation grows and there is no damming of surface water runoff.

This reports details the methodology and findings of the surface water assessment.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF PLANS

1 INTRODUCTION

Digby Wells Environmental (Digby Wells) was appointed as the independent environmental consultant to conduct the Environmental Impact Assessment (EIA) and associated specialist studies in support of a Mining Right Application (MRA) for the mining of Everest North Mine Site (Everest North) by Aquarius Platinum Limited (Aquarius).

This report details the findings of the baseline and impact assessment process on the surface water / hydrology of the proposed project area.

1.1 Project Description

The proposed project site is located in the Thaba Chweu Local Municipality, approximately 28 km north east Roossenekal and 30 km west of Lydenburg, Mpumalanga Province (Appendix A; Plan 1 – Regional Setting). The proposed project will mine platinum using both opencast and underground mining methods on the farm Vygenhoek 10 JT (Appendix A; Plan 2- Land Tenure). A waste rock dump and top soil stockpile will be established and the existing plant will be upgraded (Appendix A; Plan 3 – Mine Plan and Infrastructure). The project will include supporting services and facilities at the mining area and an upgraded interface between Everest North and Everest South Mines.

The main aim of the project is to exploit the UG2 Reef to produce a platinum group metal concentrate that will be sold with the existing product from the Everest South Mine over a Life of Mine (LoM) of 8 years. Ore produced by the mine will be processed at the existing Everest South UG2 concentrator plant. An upgrade of the front end of the plant may be required to blend the ore from Everest South with that of Everest North after accounting for the metal content in each. Co-processing of the ore will result in co-deposition of the mine residue on the existing Everest South mine Tailings Storage Facility (TSF).

The project will investigate the feasibility of expanding these facilities for the combined future requirements of Everest North and Everest South, while confirming an alternative site for final deposition. The project will further describe the supporting services and facilities for the Everest North mine only, as it is assumed that existing facilities and infrastructure at the Everest South concentrator plant will remain largely unaffected.

Waste rock from the open pit will be used for backfilling and rehabilitating the open pit. The remaining waste rock from the open pit and from the development of the underground mine will be stockpiled on site and used for construction and/ or the rehabilitation of areas such as screening berms, roads and the tailings dam. The option of a dedicated waste rock dump is also being considered. The plant will emit an inert and safe waste product in small quantities which can be stockpiled or returned to the environment.

A strip mining approach will be followed in the case of opencast mining. This will result in the topsoil, overburden and excess rock from a new pit being used to backfill an already mined out pit. Ore will be loosened through blasting, stockpiled and trucked to the concentrator plant where it will be stockpiled. On an on-going basis the, open pit will be backfilled and rehabilitated by replacing the rock followed by the subsoil, topsoil and the application of grass seed for rehabilitation.

The open pit operation will extend along the outskirts of the ore body on the farm Vygenhoek (approximately 5 km of the strike). The current plan is to start the open pit mine in the south and advance towards the north over a period of one year. The approximate depth of the proposed pit will be 70 m.

For the underground operations, there will be two decline shafts to access the underground workings. These will be developed out of the initial box cut. The underground mine will extend in a northerly direction to the boundary of the Vygenhoek farm. Ore and waste will be separated underground. Ore will be transported to the run-of-mine stockpile via trucks. The provisional mine plan is attached (Appendix A; Plan 3- Mine Plan).

2 TERMS OF REFERENCE

The terms of reference proposed in the scoping report are as follows:

A water quality assessment will be conducted and the data will be benchmarked using South African National Standards (SANS 241) for drinking water quality. Based on the activities listed throughout the different phases of the project, the proposed impacts will be assessed and the cumulative impact will be determined and rated. A surface water management and monitoring plan will also be developed for the project over the different phases of mining (construction, operation, decommissioning and post closure). The objectives outlines to execute the above ToRs are as follows:

- To determine the surface water quantity/ hydrology aspects addressing the catchment boundaries, Mean Annual Run-off (MAR) and Normal dry weather flow;
- To determine the surface water quality baseline status (in relation to South African and World Bank Standards) of the site based on collected samples and information gathered from other sources;
- To determine the surface water quality and quantity impacts of the mining activities on receiving streams;
- To propose mitigation measures for the expected impacts identified;
- To develop management plan for implementation during all phases of mining; and
- To prepare quarterly surface water monitoring reports compiled from monthly surface water quality monitoring results.

3 METHODOLOGY

The methodology of executing the EIA was undertaken in a number of phases detailed below namely:

- Desktop study;
- Site assessment; and
- Report compilation

3.1 Desktop Study

The desktop assessment entailed surface water quality and quantity assessment, site characterization and identification of the strategic baseline monitoring sites. Available information including the Water Research Commission (WRC) reports, Geographic Information systems (GIS) and the SAWS were used.

The following activities were undertaken:

- The desktop assessment was conducted to the characterise the surface water environment using existing information sources such as Water Research Commission (WRC) reports, Geographic Information Systems (GIS) and existing reports of previous work conducted within the area; and
- A selection/ identification of strategic surface water quality sampling points including up- and downstream of the project site were carried out prior to a site visit. The collected samples (based on site accessibility) would be used for the baseline characterization of the site prior to the commencement of mining.

3.1.1 **Peak Flood Estimation**

The peak flood volume for the 1: 50 and 1: 100 return year periods was determined using the (UPD) software (SANRAL, 2007). The calculation took into account parameters determined from the delineated sub-catchments.

The selected methods used for flood peak volume estimation are:

- Rational;
- Standard Design Flood (SDF); and
- Alternative rational method.

3.1.1.1 Rational Method

This method is based on the conservation of mass and is applicable for catchment areas below 15 km^2. Aerial and time distributions of rainfall in this method are assumed to be uniform throughout the catchment. Flood peaks and empirical hydrographs can be determined by this method.

3.1.1.2 Standard Design Flood

The standard design flood method (SDF) was developed to address the uncertainty in flood prediction under South African conditions. It is based or historical data to adequately describe the flood frequency relationships. The runoff or discharge coefficient (C) is replaced by a calibrated value based on the sub division of the country into 26 regions or WMAs historical data. This method can work any catchment size catchments without any limitation.

3.1.1.3 Alternative Rational Method

This method is based on the rational method with the point precipitation being adjusted to take into account local South African conditions. This method can work for various catchments sizes without any limitation.

3.1.1.4 Model Parameters

The information used to conduct the model assessment for the three selected methods were specified using various criteria summarised below and detailed in the Drainage Manual (SANRAL, 2007). The percentages of each of these classes were then determined by professional subjective judgement/discretion, and visual inspection on the terrain and fraction of the catchment area occupied. The most important parameters were:

- Area distribution – which is estimated based on the catchment area and respective areas covered by the rural, urban and reservoirs;
- Rural area surface slope – which was characterised based on the respective slope (%) classifications to define flat areas from hilly areas and steep area;
- Rural area permeability – which is estimated from the a qualitative guide of soil texture for the classification of the soil permeability as in the Drainage Manual (SANRAL, 2007) and soil maps (1:250 000 interactive map from Agricultural Research Council) and estimation of percentage area by visual inspection;
- Vegetation – which was estimated from site inspections observations and satellite imagery visual classification;
- Urban area parameters – which were based on site observations and inspections;
- The number of days on which thunder was heard – obtained from the WRC Report and the SAWS. The weather stations used for the catchment B41G is the Maaartenshoop;
- Dolomitic areas – the percentage dolomitic area was determined based on the geology map and using visual inspection and estimation however in this study Area there are no dolomitic areas; and
- Overland or defined water course flow – where the average slope of a catchment greater than 5% and catchment larger than 5 km2 assumes that defined water courses exist.

3.2 Site Assessment

The following activities were undertaken during the site visit:

- Gaining an understanding of the project site and confirming the existence of the surface water resources as captured in the desktop assessment; and
- Collection of surface water quality samples from up- and downstream of the project site; and
- The samples were submitted to a South African National Accreditation Standards (SANAS) accredited water quality laboratory for physical, chemical and microbiological analyses;

3.2.1 Water Monitoring Programme

Surface water sampling points identified during the baseline study will be used to prepare a monitoring plan that will verify the impacts of the mining activities on the surface water resources in the catchment area. A surface water monitoring plan will be developed in order to manage the water quality for downstream water users.

3.3 Report Compilation

The report compilation process included the following:

- Collation of the desktop study information to characterise the site hydrology;
- Interpretation of the water quality data from the laboratory to determine the baseline in line with the South African and World Bank standards;
- Identification of impacts related to the project's listed activities and weighting of impact to determine pre-mining significance;
- Recommendation of mitigation measures and determination of post mining significance;
- Development of the surface water management plan for implementation during mining; and
- Development of monitoring plan including undertaking one year (12 months) monitoring and compilation of quarterly surface water monitoring reports.

4 QUALIFICATION OF THE SPECIALIST

Digby Wells Environmental is an independent Environmental Management service provider consisting of a team of environmental specialist including hydrologist and hydrogeologists. Dr Jennifer Molwantwa is a surface water quality specialist and Unit Manager Hydrology with six years' experience in the field of mine water treatment and making surface water quality inputs into Environmental Impact Assessments (EIA)/ Environmental Management Programmes (EMP), Integrated Water and Waste Management Plans and in the application of Integrated Water Use Licenses (IWUL) or the mining industry clients. CV and declaration of independence is appended (Appendix B)

5 LEGAL FRAMEWORK

In accordance with Section 23(5) of the Mining and Petroleum Resources Development Act (MPRDA), the Mining Right will only come into effect on approval of the Environmental Impact Assessment (EIA)/ Environmental Management Programme (EMP). The assessment of environmental impacts is legislated under the National Environmental Management Act (Act 107 of 1998) (NEMA) and includes surface water quality and quantity assessment as part of the specialist investigations. The content of the surface water assessment is also dictated by the NEMA process, the National Water Act (Act 36 of 1998) (NWA) and the NWA amendment of Regulation (GN R) 704 for use of water in mining. The management of water resources and use of water in mining is also guided by the Department of Water Affairs (DWA) Best Practice Guidelines (BPGs) series (DWA, 2008).

The above legislative requirements were applied in the surface water quality and quantity assessment report detailed here.

6 STUDY AREA

The proposed project is located in the Groot Dwars River Catchment of the Olifants Water Management Area (WMA 01) and lies within the quaternary catchment B41G (Appendix A; Plan 4 – Catchments). The Groot Dwars River is a tributary of the Steelpoort River within in the Olifants River Basin (Appendix A; Plan 5 – Surface Water Resources). The total project site covers an area of 7.15 km^2 which represents 1.6% of the total B41G area of 442 km^2.

The proposed project area is characterised by hilly topography with 2 valleys cutting through the project area on the west and the eastern side. These valleys hold two unnamed tributaries of the Dwars River, which flow in a northerly direction from the site. These two feed the Groot Dwars River approximately 4.5 km downstream of the project site. The Dwars River is a tributary of the Steelpoort River and drains into the Steelpoort River approximately 24 km north of the proposed site for the project area.

Streams in the project area are sustained by shallow groundwater flow (baseflow) and where groundwater discharges in the lower lying areas, wetland habitats are maintained. Springs also occur in the project area and the streams were observed to be flowing steadily during the sampling season.

The Everest North mining area is characterised as a rural, agricultural and mining area. There are other mines existing in the proximity of the proposed mine (Plan 1). The water users in the area include agriculture (crop irrigation and the watering of livestock and game). Thus it is imperative to ensure that in the execution of the project there is maximum management to prevent/reduce the impact on the surface water environment.

6.1 Climate

The proposed project area is located on the eastern escarpment on the border of the Highveld and Northern Transvaal climatic zones (Schulze, 1974). Shadow effects are likely to affect microclimate, especially in winter, by reducing temperature and increasing moisture holding capacity on southern slopes. In summer, elevated areas are frequently exposed to mist that accompanies the inflow of moist air from the Indian Ocean.

6.1.1 Temperature

The mean monthly temperature is indicated in Figure 1 based on the Lydenburg weather station mean monthly temperatures. These temperatures were obtained from the FAO Climate data generator FAO Clim2 (2003). Winter temperatures are fair as they do not fall to freezing points.

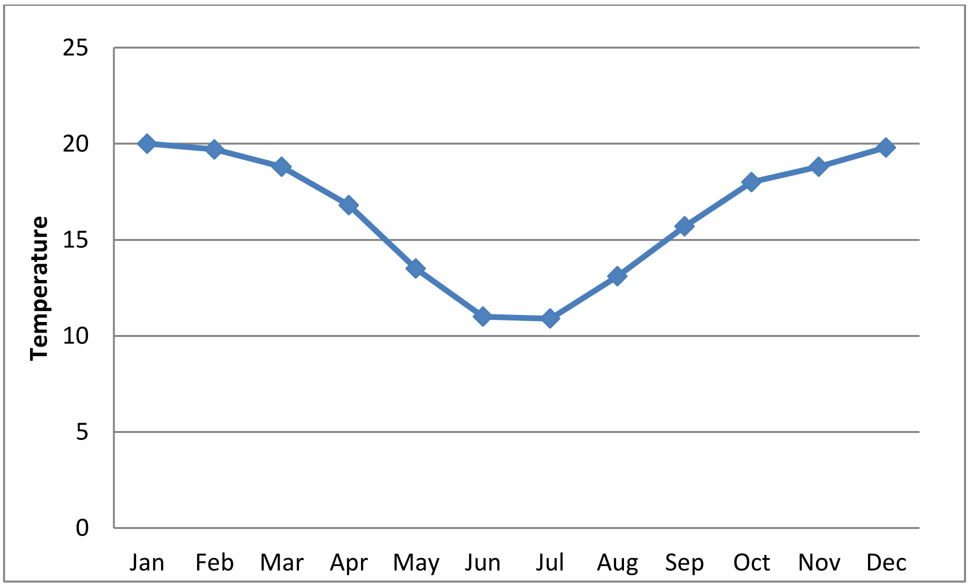

Figure 1: Summary of mean monthly temperatures for Lydenburg weather station

6.1.2 Rainfall

Rain falls in the area in the form of showers and thunderstorms and mostly between October and March. Figure 2 indicates the mean monthly total rainfall volume as derived from South African Weather Services (SAWS) database for Lydenberg for the years 1990 to 2006. These indicate dry winters and wet summers with the lowest rainfall falling between June and August while the rainy season is from October to March.

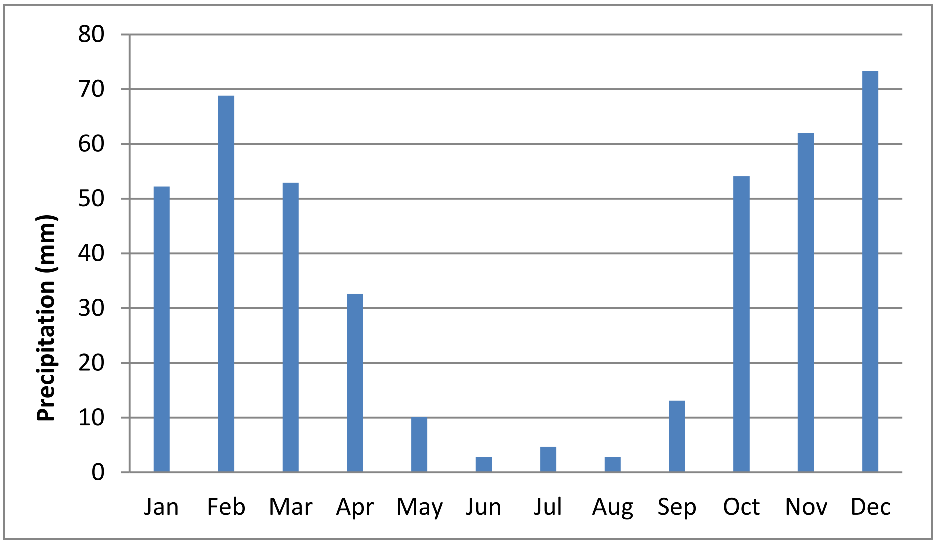

Figure 2: Summary of rainfall for Lydenburg weather station for the period 1990 to 2006

7 EXPERTISE OF THE SPECIALIST

Digby Wells is an independent Environmental Consulting firm providing service to the mining industry. There is a suite of in-house specialists including hydrologists and hydro geologists. A declaration of independence is appended (Appendix B) and a CV of the specialist is available upon request.

8 FINDINGS

The surface water assessment methodology entailed a desktop assessment, site assessment and report compilation.

8.1 Hydrology/ Surface Water Quantity

The hydrology characteristics of the site are detailed in the Sections below.

8.1.1 Catchment Characteristics

The catchment characteristics are summarised in Table 1 indicating a 10% conversion of MAP to MAR (WRC, 1994).

Table 1: Quaternary Catchment Characteristics

Catchment	Catchment Area (km^2)	Project Area (km^2)	% Project Area Catchment	MAP (mm)	MAR (mm)	MAE (mm)	% MAR/ MAP
B41G	442	7.15	1.6	650	66	1500	10

8.1.2 24- Hour Rainfall Depths

Two weather stations close to the study area were considered for the assessment of a 24 hour storm. These are the Lydenburg Weather Station (WD 0554816) located 31 km east of the project area at 25˚ 00’ South and 30 ˚ 28’ East and Beetgeskraal Weather Station (0554516), located about 9 km east of the project Area at 25 ˚ 5’ South and 30 ˚16’ East. To be able to determine the design 24 hour rainfall depths for the 1: 50 and 1: 100 year return periods, the Design Rainfall Estimation in South Africa software (Smithers and Schulze, 2003) was utilised. The summarised data is presented in Table 2. The maximum rainfall depth that can be recorded over a 24 hour storm in the area could be on average 159 and 182 mm for a 1: 50 and 1: 100 year event respectively.

Table 2: Estimated 24 Hour Rainfall depths

Return Period (years)	1: 50	1: 100
Station Name (Number)	**24 Hour Rainfall Depth (mm)**	
Lydenburg (0554816)	162	186
Beetgeskraal (0554516)	156	177

8.1.3 Catchment Delineation

To be able to calculate flood peaks, the quaternary catchment B41G (Appendix A; Plan 4 – Quaternary Catchments) was delineated into 6 sub-catchments around the project site (Appendix A; Plan 6- Sub-catchments).

The two unnamed tributaries were named tributary 1 and 2, where tributary 1 is the stream that flows on the west valley and tributary 2 drains the project site on the east. These two drain to a confluence with the Groot Dwars River. Table 3 indicates the catchment characteristics useful for the flood peak modelling. A summary of the delineated sub-catchment characteristics is presented in Table 4.

Table 3: Sub-catchment delineation summary for B41G quaternary catchment

Sub-catchment	Description
sub1	Upstream project area tributary 1
sub2	Project Area on tributary 1

Sub-catchment	Description
sub3	Upstream project area on tributary2
sub4	Project Area on tributary 2
sub5	Downstream of Project Area on tributary 2
sub6	Downstream project area on tributary 1

Table 4: Sub-Catchment characteristics

Catchment	Area (km2)	Longest Stream Length (km)	Elevation difference at 85% and 10% river length (m)	Distance from outlet to centroid (km)
sub1	7.5	5	130	2.7
sub2	7.2	4	210	1.8
sub3	4	3	52	1.4
sub4	10.5	4	69	1.8
sub5	9.8	3	237	2
sub6	6.2	2	40	1.1

The catchment area that encloses the project area (the watershed for Dwars River tributaries draining the project area) is approximately 45 km^2, which covers 11% of the quaternary catchment B41G.

8.1.4 Hydrograph Analysis

Separation of the base flow was performed to be able to further understand the hydrology of the area. From the baseflow determined the low flow was determined as the average annual equivalent low baseflow that is equalled or exceeded during 75% of the time during the 4 driest months (May to August) of the year.

The method used is the Digital Filter method in Web-based Hydrograph Analysis Tool (WHAT). This method uses a filter parameter to separate quick flow (inter flow and storm runoff) from baseflow as discussed in several studies for South African conditions. The difference between quick flow and total stream flow is assumed to be baseflow. A hydrograph analysis of the estimated baseflow is illustrated in Figure 3.

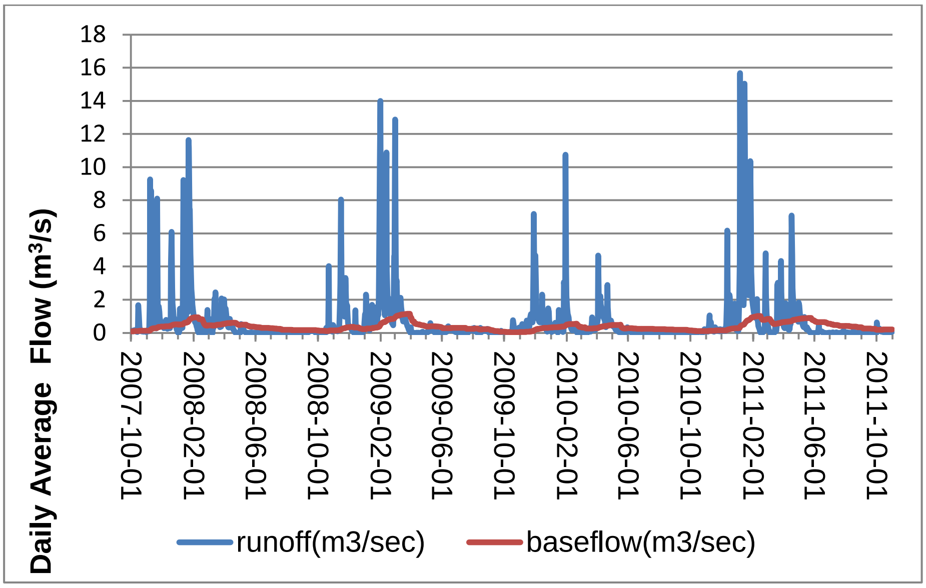

Figure 3: Hydrograph separation of the streamflow (DWA, 2012) into daily mean baseflow and runoff (m^3/sec) for the period 2006 to 2011

The baseflow for the catchment was determine to by considering the daily stream flow time series data from DWA Gauge B4H009 situated 14.4 km from the project site. The low flow was determined to be a daily average of between zero and 0.02 m^3/s. Although these are low flow rates, best management practices need to be appropriately applied to reduce and intercept pollutant leaching if base flow contributes significant amounts of pollutants to the stream. A Base flow Index (BFI) of 0.38 was determined. The Baseflow Index (BFI) is the ratio between baseflow and total flow. Therefore a BFI of 0.38 indicates that 38 % of total stream flow can be attributed to baseflow for the respective time period on average from 2006 – 2011.

8.1.5 Flood Peak Volume Estimation

The delineated sub-catchments (Table 5) were utilized to calculate the flood volumes. The peak flood volumes were determined using the Utilities Programmes for Drainage (UPD) software (SANRAL, 2007). The flood volumes calculated are presented in Table 6. The actual values for the model parameters for each sub-catchment are shown in the detailed model results (Appendix C - Flood Volume Results).

Table 5: Estimated Flood Peaks (m^3/s) for the delineated sub-catchments

Catchment	1:50			1:100		
	Rational	Alternative rational	Standard Design Flood (SDF)	Rational	Alternative rational	Standard Design Flood (SDF)
sub1	81	71.4	82	104	86	104
sub2	110	116	108	142	141	137
sub3	52	53	52	67	64	65
sub4	124	126	115	159	153	146
sub5	178	184	162	228	223	207
sub6	87	92	103	112	112	132

The flood peaks determined from the 3 methods were highly comparative for each of the sub-catchments. The ranges were close to each other for each of the return period. It can then be meaningful to determine the flood peak volumes for the 1: 50 and 1: 100 year return periods as the average value of the 3 methods (Table 6).

Table 6: Average Flood Peaks (m^3/s) based on the 3 methods

Catchment	1:50	1:100
sub1	78	98
sub2	111	140
sub3	52	65
sub4	122	153
sub5	175	219
sub6	94	119

The determined runoff volumes are high for the small catchment sizes and this was attributed to the hilly nature of the area and the presence of steep slopes. The catchments with relatively steep slopes had large elevation difference between the 10% and 85% stream length.

In line with the legislative requirements, the constructed infrastructure for containing dirty water should be able to contain the 1:50 year 24 hour flood peak flow of 189 m^3/s flow (total volume of 16 000 000 m^3) for sub-catchment 1 and 2 in which the proposed project area falls.

8.2 Surface Water Quality

The assessment entailed confirmation of the site characteristics, confirmation of sampling sites and sample collection and the submission of the sample to a South National Accreditation Systems (SANAS) accredited laboratory for the analysis of chemical variables.

8.2.1 Sample Collection

The project area is characterised by hilly terrain with steep slopes and valleys. As a result of the terrain, most of the proposed sampling sites from the scoping phase were inaccessible. However during the baseline assessment on the 16th February 2012, only five samples (out of and the identified 12) were collected (Appendix A; Plan 7- Surface Water Sampling Sites). The collected samples were labelled SLY (Sylvania) SW (Surface Water) 01 (number) as indicated in Table 7 (indicating location and site description).

Table 7: Summary of the sampled points and location description

Site ID	Latitude	Longitude	Site Description
SLY SW05	-25.034583	30.149778	Downstream of project area on Dwars River tributary 1 at the edge of the proposed overburden stockpile footprint
SLY SW06	-25.071738	30.162814	Upstream of project area on Dwars River tributary 1 downstream of
SLY SW07	-25.056802	30.168937	Upstream into the project area footprint on the Dwars River tributary 2
SLY SW08	-25.069893	30.162499	Upstream of project Area on the downstream of SYL06 on Dwars River tributary 1
SLY SW12	-25.062521	30.162204	Upstream of project Area on Dwars River tributary 1.

8.2.2 Variables Analysed

The following hydrochemical elements were analysed in the collected samples:

- Total Dissolved Solids (TDS);
- Sulphate as SO_4;
- Sodium as Na;
- Magnesium as Mg;
- Nitrate NO_3 as N;
- Fluoride as F;
- Calcium as Ca;
- Potassium as K;
- Chlorides as Cl;
- Iron as Fe;
- Manganese as Mn;
- Electrical Conductivity (EC);
- Total Alkalinity as $CaCO_3$;
- pH-Value at 25° C;

- Aluminium as Al; and
- Free and Saline Ammonia as N.

8.2.3 Data Analysis

The laboratory data (Appendix D) was captured and interpreted using the Water Interpretation Software for Hydrogeologists (WISH) to indicate the water quality of the samples collected. The water quality was benchmarked against the South African National Standards (SANS) 241 for drinking water (2011). The water quality results were also benchmarked against the World Bank standards mainly the World Health Organisation (WHO, 2011).

8.2.4 Surface Water Quality

The chemical analysis results of water samples collected in February 2012 (Appendix D) were evaluated against the SANS 241 (2011) drinking water quality standards as summarised in Table 8 and against the WHO (2011) guidelines for drinking water as summarised in Table 9. The presentation of the results is colour coded to present the Class I and Class II water quality respectively (SANS 241). Where Class I is recommended for drinking water purposes and Class II is drinkable water quality but for limited allowed time of exposure. Values that exceeded Class II are colour coded in red shading. The graphical presentation of the data in WISH graphs is appended (Appendix E).

Water quality data indicated in Table 9, depicted that based on the SANS water guidelines, all variables except Fe, were within class I. The Fe was in Class II for these samples taken at SYL SW 06, 08 and 12.

In terms of the WHO 2011 guidelines for drinking water, the variables analysed were within the drinking water limits with the exception of Fe.

The elevated Fe concentration as shown in both tables could be attributed to the natural geological formations in the area. It is important to note that metals in water supply may occur naturally or may be the result of contamination. Naturally occurring metals are dissolved in water when it comes into contact with rock or soil material. Metals should be removed from drinking water if they are present at high levels that could present a health risk. In this particular case, the iron levels are in the allowable levels although above the ideal. The water for these sampling points still falls in the Class I because Iron in water is not an immediate health hazard by itself. However it may increase the hazard of pathogenic organisms, since many of these organisms require iron to grow.

On comparing the various sampling sites, the sampling point SYL SW05 had relatively higher concentration of Ca, EC, Mg, Na and TDS as compared to the other sampling points (Plan 7) although the levels were still within Class I. This sampling site requires closer monitoring and control to prevent the water quality from deteriorating further as a result of the mining activities.

Table 8: Chemical Results benchmarked against the SANS 241: 2011 standards

Sample ID		Total Dissolved Solids	Nitrate NO_3 as N	Chlorides as Cl	Total Alkalinity as $CaCO_3$	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Iron as Fe	Manganese as Mn	Conductivity at 25° C in mS/m	pH-Value at 25° C	Aluminium as Al	Free and Saline Ammonia as N	Fluoride as F
Class I	(Recommended)	<1000	<10	<200	N/S	<400	<150	<70	<200	<50	<0.2	<0.1	<150	5-9.5	<0.3	<1	<1
Class II	(Max. Allowable)	2400	20	600	N/S	600	300	100	400	100	2	1	370	4-5 or 9.5-10	0.3-0.5	2	1.5
	Duration (years)	7	7	7	N/S	7	7	7	7	7	7	7	7	No Limit	1	None	1
SLY SW05		346	-0.06	5.80	353	9.09	62.8	44.7	10.5	1.08	-0.01	0.00	66.3	7.85	-0.01	0.08	-0.18
SLY SW06		59.0	-0.06	3.90	52.7	4.50	9.06	8.83	0.99	-0.04	0.78	0.00	10.4	8.05	-0.01	0.04	-0.18
SLY SW07		34.0	-0.06	2.00	29.3	2.94	5.17	5.87	-0.03	-0.04	-0.01	0.00	7.71	7.69	-0.01	0.03	-0.18
SLY SW08		59.0	-0.06	3.60	47.8	7.72	9.03	8.82	1.53	-0.04	0.81	0.00	9.95	7.88	-0.01	0.02	-0.18
SLY SW12		50.0	-0.06	2.60	46.6	2.00	9.75	7.18	0.71	-0.04	0.75	0.00	11.6	8.02	-0.01	0.04	-0.18

Table 9: Chemical Results benchmarked against the World Bank WHO Standards

Sample ID	Total Dissolved Solids	Nitrate NO_3 as N	Chlorides as Cl	Total Alkalinity as $CaCO_3$	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Iron as Fe	Manganese as Mn	Conductivity at 25° C in mS/m	pH-Value at 25° C	Aluminium as Al	Free and Saline Ammonia as N	Fluoride as F
(Recommended) WHO, 2011	1000	50	250	N/S	250	N/S	N/S	200	N/S	0.3	0.1	NS	6.5-8.5	0.2	NS	1.5
SLY SW05	346.00	-0.06	5.80	353.80	9.09	62.80	44.76	10.54	1.08	-0.01	0.00	66.30	7.85	-0.01	0.08	-0.18
SLY SW06	59.00	-0.06	3.90	52.70	4.50	9.06	8.83	0.99	-0.04	0.78	0.00	10.38	8.05	-0.01	0.04	-0.18
SLY SW07	34.00	-0.06	2.00	29.30	2.94	5.17	5.87	-0.03	-0.04	-0.01	0.00	7.71	7.69	-0.01	0.03	-0.18
SLY SW08	59.00	-0.06	3.60	47.80	7.72	9.03	8.82	1.53	-0.04	0.81	0.00	9.95	7.88	-0.01	0.02	-0.18
SLY SW12	50.00	-0.06	2.60	46.60	2.00	9.75	7.18	0.71	-0.04	0.75	0.00	11.58	8.02	-0.01	0.04	-0.18

9 WATER USES

Surface water in the project area is used for domestic purposes and agricultural (crop irrigation and livestock watering) activities. A large portion of Ehlanzeni District is dominated by rural areas, with many people not having full access to potable water. The local settlers in the area had no borehole water and this leaves the only source of water to be direct from the stream upstream of the project area.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

The following conclusions can be drawn from the baseline assessment:

- The proposed project could impact on a the delineated sub-catchments covering 11% of the quaternary catchment B41G;
- The surface water quality baseline indicates that the surface water resources on the tributaries to the Groot Dwars River draining through the proposed project area are in Class I and II of SANS drinking water standards which indicates a relatively pristine rural environment; and
- The variable that could potentially cause concern due to it falling in Class II in the present baseline state of the surface water is Fe.

10.2 Recommendations

The following recommendations are made:

- The design of the water holding facilities for the a 1 : 50 yr flood volume should at least be able to contain a flow of 189 m^3/s for a 24 hour duration (16 000 000 m^3);
- Water quality monitoring must be carried out regularly and used as an impact detection tool; and
- Although the area is already impacted upon by other mining and agricultural activities within the area, it is essential that the management of the project execution ensures that there are minimal impacts to the surface water resources.

11 IMPACT ASSESSMENT

The impact assessment methodology designed by Digby Wells was utilised to assess the impacts that could arise from the sixteen listed activities over the construction, operation and decommissioning and post closure phases (Table 10).

Table 10: Summary of project listed activities

Phase		Activity
Construction	1	Site Clearing: Removal of topsoil & vegetation
	2	Construction of any surface infrastructure e.g. haul roads, pipes, storm water diversion berms (including transportation of materials

Phase		Activity
		& stockpiling)
	3	Drilling, blasting and development of initial boxcut for mining (incl. stockpiling from initial cuts).
	4	Temporary storage of hazardous product (fuel, explosives) and waste or sewage.
Operation	5	Removal of overburden and backfilling when possible (including drilling/blasting hard overburden & stockpiling)
	6	Use and maintenance of haul roads
	7	Removal of ore (mining process) and ROM ore Stockpile
	8	Water use & storage on site (incl. screening & washing, PCD)
	9	Storage, handling and treatment of hazardous products (fuel, explosives, oil) and waste activities (waste, sewage, discard, PCD)
	10	Concurrent replacement of overburden, topsoil and revegetation
Decommissioning	11	Demolition & Removal of all infrastructure (incl. transportation off site)
	12	Rehabilitation (spreading of soil, re-vegetation & profiling/contouring)
	13	Installation of post-closure water management infrastructure
	14	Environmental monitoring of decommissioning activities
	15	Storage, handling and treatment of hazardous products (fuel, explosives, oil) and waste activities (waste, sewage, discard)
Post-closure phase	16	Post-closure monitoring and rehabilitation

11.1 Impact Assessment Methodology

In order to clarify the purpose and limitations of the impact assessment methodology, it is necessary to address the issue of subjectivity in the assessment of the significance of environmental impacts. Even though DWA, and the majority of EIA practitioners, propose a numerical methodology for impact assessment, one has to accept that the process of environmental significance determination is inherently subjective. The weight assigned to the each factor of a potential impact, and also the design of the rating process itself, is based on the values and perception of risk of members of the assessment team, as well as that of the I&AP's and authorities who provide input into the process. Whereas the determination of the spatial scale and the duration of impacts are to some extent amenable to scientific enquiry, the severity value assigned to impacts is highly dependent on the perceptions and values of all involved.

It is for this reason that it is crucial that all EIA's make reference to the environmental and socio-economic context of the proposed activity in order to reach an acceptable rating of the significance of impacts. Similarly, the perception of the probability of an impact occurring is dependent on perceptions, aversion to risk and availability of information.

It has to be stressed that the purpose of the EIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context. The methodology employed for EIA is divided into two distinct phases, namely, impact identification and impact assessment.

11.1.1 **Impact Identification**

Impact identification is performed by use of an Input-Output model which serves to guide the assessor in assessing all the potential instances of ecological and socio-economic change, pollution and resource consumption that may be associated with the activities required during the construction, operational, closure and post-closure phases of the project. Outputs may generally be described as any changes to the biophysical and socio-economic environments, both positive and negative in nature, and also include the product and waste produced by the activity. Negative impacts could include gases, effluents, dust, noise, vibration, other pollution and changes to the bio-physical environment such as damage to habitats or reduction in surface water quantity. Positive impacts may include the removal of invasive vegetation, construction of infrastructure, skills transfer or benefits to the socio-economic environment. During the determination of outputs, the effect of outputs on the various components of the environment (e.g. topography, water quality, etc.) is considered.

During consultation with I&APs perceived impacts were identified. These perceived impacts will become part of the impact assessment and significance rating in order to differentiate between probable impacts and perceived impacts.

11.1.2 **Impact Rating**

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the Input-Output model. As discussed above, it has to be stressed that the purpose of the EIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context.

This gives the project proponent a greater understanding of the impacts of his project and the issues which need to be addressed by mitigation and also give the regulators information on which to base their decisions.

The equations and calculations were derived using Aucamp (2009).

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability

Where Consequence = Severity + Spatial Scale + Duration

And Probability = Likelihood of an impact occurring

The matrix calculates the rating out of 147, whereby severity, spatial scale, duration and probability are each rated out of seven (Table 11). The weighting is then assigned to the various parameters for positive and negative impacts in the formula. Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the EMP.

Table 11: Impact Assessment Parameter Ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	**Social, cultural and heritage**			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Very serious widespread social impacts. Irreparable damage to highly valued items	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects.	On-going serious social issues. Significant damage	Municipal Area Will affect the	Long term	Probable Has occurred here or elsewhere and could

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
	Environmental damage can be reversed in less than a year	to structures / items of cultural significance	whole municipal area	6-15 years	therefore occur.
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month.	On-going social issues. Damage to items of cultural significance.	<u>Local</u> Local extending only as far as the development site area	<u>Medium term</u> 1-5 years	<u>Unlikely</u> Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	<u>Limited</u> Limited to the site and its immediate surroundings	<u>Short term</u> Less than 1 year	<u>Rare/ improbable</u> Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment.	Low-level repairable damage to commonplace structures.	<u>Very limited</u> Limited to specific isolated parts of the site.	<u>Immediate</u> Less than 1 month	<u>Highly unlikely/None</u> Expected never to happen.

The significance of an impact is then determined and categorised into one of four categories (Table 12).

Table 12: Probability Consequence Matrix

Significance										
		Consequence (severity + scale + duration)								
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

The significance rating is presented in Table 13. In accordance with Regulation 51 of the MPRDA, management actions will be assigned for all identified impacts.

Table 13: Significance Threshold Limits

Significance		
High	**108- 147**	
Medium-High	**73 - 107**	
Medium-Low	**36 - 72**	
Low	**0 – 35**	

11.2 Construction Phase

During the construction phase, there will be site clearing, construction of infrastructure, drilling and blasting. There will be the temporary storage of hazardous products (explosives) and commencement of the long-term storage of hydrocarbon containing substances such as grease, oil and diesel. The surface water quality impacts that could arise from the construction phase activities and mitigation measures are discussed below.

11.2.1 Activity 1: Site Clearing and Removal of Topsoil and Vegetation

11.2.1.1 Impact Description: Surface Water Quantity

The clearance of the site results in increased surface runoff which will be prevented from reporting to the catchment as it will be contaminated with silt. This will be a common impact possibly during the opencast mining period.

11.2.1.2 Impact Assessment

Parameter	**Impact Pre-Mitigation**		**Impact Post-Mitigation**	
Duration	Long Term	4	Medium term	3
Scale	Regional	5	Local	3
Severity	Serious Medium	4	Minor effects	2
Likelihood	Likely	5	Probable	4
Significance	Medium low	65	Low	32

11.2.1.3 Mitigation Description

There is an essential requirement to limit the cleared area as much as possible in order to reduce the quantity of contaminated runoff water that cannot report to the catchment. This will be possible with the implementation of roll-over mining where a limited area will be mined at a given time.

11.2.1.4 Impact Description: Surface Water Quality

The clearance of the site results in increased dust generation and potential soil erosion. This could result in silted runoff flowing through the surface to the water resources. The resultant impact could be increased siltation and water quality deterioration of the catchment.

11.2.1.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long-term	4	Medium term	3
Scale	Local	3	Local	3
Severity	Moderate short term	3	Moderate short term	3
Likelihood	Probable	4	Unlikely	3
Significance	Medium low	40	Low	27

11.2.1.6 Mitigation Description

It is essential to implement clean and dirty water separation and ensure that the dirty area is minimized. Dust suppression measures have to be implemented. The constructed isolation topsoil berms must be vegetated to prevent erosion and the water associated with the dirty area must be contained in Pollution Control Dams (PCDs).

11.2.2 Activity 2: Construction of any Surface Infrastructure

This activity includes the construction of haul roads, pipes, storm water diversion berms (including transportation of materials & stockpiling).

11.2.2.1 Impact Description: Surface Water Quantity

There will be increased surface runoff flow on the dirty area as a result of the compaction to create hard park areas on which to constrict infrastructure. This runoff will be prevented from reporting to the catchment as it will be isolated/ contained within the mine site and this will result in decreased quantity of runoff water reporting to the catchment.

11.2.2.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project life	5	Medium term	3
Scale	Regional	5	Local	3
Severity	Serious medium term	4	Moderate	3
Likelihood	Probable	4	Unlikely	3

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Significance	Medium low	56	Low	27

11.2.2.3 Mitigation Description

Ensure that clean water is diverted to the catchment with minimal contact with contaminated water. The silt traps could be fitted to ensure that more treated run-off is diverted to the surface water environment.

11.2.2.4 Impact Description: Surface Water Quality

Surface water quality deterioration could result from accidental spillages of construction material, hydrocarbon containing material (such as oils and diesel from heavy machinery) and other hazardous materials (chemical toilets materials), if not detected early could result in water quality deterioration that could spread from the site, through the local up to regional areas. The siltation from dust deposition and soil erosion will also result in surface water quality impacts throughout the LoM.

11.2.2.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Permanent: Mitigation	5	Medium term	3
Scale	Regional	4	Local	3
Severity	Serious medium term	4	Moderate	3
Likelihood	Likely	5	Unlikely	3
Significance	Medium low	65	Low	27

11.2.2.6 Mitigation Description

The handling of hazardous and other materials should be by accredited contractors, Code of Practice (COP) documents should be developed and the mining contractors should implement these at all times and on-site cleaning spillage kits should be available and mining personnel should be trained on their use in order to clean up immediately after accidental spillages. The establishment of storage areas on compacted hard-park area with bunding will prevent the spread of contaminants in cases of spillages.

Separation of clean and dirty water by means of vegetated topsoil berms and monitoring of vegetation growth on the berms will reduce the rate of soil erosion and subsequent siltation. The implementation of dust suppression measures will reduce dust deposition in the surface water environment.

11.2.3 Activity 3: Drilling, Blasting and Development of Initial Box Cut

11.2.3.1 Impact Description: Surface Water Quantity

Blasting and drilling could result in fractures in the aquifers bed that would result in altered water flows and baseflow drawdown thus reducing the water contributing to stream flow. The box cuts result in areas where water could collect and accumulate instead of flowing and reporting to the catchment.

11.2.3.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project Life	5	Project life	5
Scale	Regional	5	Municipal area	4
Severity	Very serious	5	Moderate	3
Likelihood	Likely	5	Probable	4
Significance	Medium high	75	Low	48

11.2.3.3 Mitigation Description

It is important to avoid drilling and blasting in close proximity to the stream and adhere to the blast pattern so that blasting and detonation is done well and avoid cracks in the aquifer bed in unplanned fashion. Stream flow monitoring is also necessary during this time to ensure that impacts on surface water quantity are detected and mitigation is implemented.

11.2.3.4 Impact Description: Surface Water Quality

Negative impacts could arise from the improper use of explosives, spillages from undetonated explosive material (nitrate and ammonia) and waste left behind after detonation. Heavy vehicle movement could result in elevated dust levels which could result in the siltation of nearby surface water resources. The diesel leakages from the trucks and filling station on site could result in the surface water contamination should run-off be allowed to flow off-site. Oil for the hydraulic drilling machines can pose a hydrocarbon contamination impact as well to the water quality.

11.2.3.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Permanent –Mitigation	6	Project Life	5
Scale	Regional	5	Regional	5
Severity	Very serious	5	Very serious	5
Likelihood	Likely	5	Unlikely	3
Significance	Medium high	80	Medium low	45

11.2.3.6 Mitigation Description

Ensure water quality monitoring and dust suppression is implemented and allow only trained and certified personnel to conduct the blasting and drilling. This will ensure that adequate quantities of explosives are utilised to minimise excess waste and the remaining rubble is correctly disposed. Regular monitoring of hydraulic machines and fitting them with drip trays could ensure prevention of hydrocarbon contamination.

11.2.4 Activity 4: Temporary Storage of Hazardous Products (fuel, explosives) or Waste or Sewage

11.2.4.1 Impact Description: Surface Water Quantity

There will be decrease in water quantity reporting to the catchment from runoff where storage facilities areas and sewer storage areas are isolated from the rest of catchment.

11.2.4.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project life	5	Medium term	3
Scale	Local	3	Local	3
Severity	Moderate	3	Moderate	3
Likelihood	Probable	4	Unlikely	3

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Significance	Medium low	44	Low	27

11.2.4.3 Mitigation Description

It is important to ensure free drainage of as much clean storm water as possible to the catchment and use one designated hazardous substances storage facility to reduce number of highly toxic dirty areas.

11.2.4.4 Impact Description: Surface Water Quality

The water quality impacts could arise from the pro-longed leakages or instant spillages of the hazardous and hydrocarbon containing materials.

11.2.4.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Permanent: Mitigation	6	Medium term	3
Scale	Regional	5	Municipal Area	4
Severity	Significant	6	Serious medium term	4
Likelihood	Probable	4	Probable	4
Significance	Medium high	76	Low	44

11.2.4.6 Mitigation Description

The storage and handling of hazardous and hydrocarbon containing material should be in line with GN R 704 regulations. The storage areas have to be located on a hard park area with a bund wall to prevent the spread of material to the water resources in case of spillages. Only trained and authorized personnel must be granted access the storage facilities and the explosives magazine areas. Use of hazardous material must be only by trained and authorized personnel. On-site clean up kits must be made available to prevent pro-longed exposure when there are accidental spillages.

11.3 Operational Phase

The operation phase of this project includes the removal of overburden material, initial box cut. The impact of these activities is discussed below.

11.3.1 Activity 5: Removal of Overburden and Backfilling when Possible

This activity would include drilling/ blasting hard overburden and stockpiling

11.3.1.1 Impact Description: Surface Water Quantity

There will be a decrease in water quantity reporting to the catchment as dirty and clean areas are separated. The drilling and blasting could cause aquifer bed fractures and alteration resulting in fewer bases flow water flowing to the streams. Baseflow is important in this catchment where most of the surface flow is mostly from the shallow groundwater aquifer.

11.3.1.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project Life	5	Project Life	5
Scale	Regional	5	Local	3
Severity	Very serious	5	Serious- medium term	4
Likelihood	Probable	4	Unlikely	3
Significance	Medium low	60	Medium Low	36

11.3.1.3 Mitigation Description

It is important to minimise the disturbed area in order to limit the runoff volume that cannot report to the catchment. It is also essential that the backfilled areas are well graded to closely resemble original contour and minimise erosion and storm water collection points. Grass seeding the area to grow vegetation on rehabilitated area will prevent the increased flow of runoff from the area. Systematic and well controlled drilling and blasting is also important to reduce impacts.

11.3.1.4 Impact Description: Surface Water Quality

Water quality impacts could arise from soil erosion of the stockpiles and the cleared areas which could lead to sedimentation of rivers.

11.3.1.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project Life	5	Project life	5
Scale	Regional	5	Local	3
Severity	Very serious	5	Moderate	3
Likelihood	Likely	5	Unlikely	3
Significance	Medium high	75	Low	33

11.3.1.6 Mitigation Description

Reduce the extent of the cleared areas at each particular time and construct berms around the topsoil/ overburden stockpiles. Water quality monitoring to be conducted on a monthly basis where negative water quality impacts are detected, the frequency of monitoring must be increased and the source of pollution must be detected.

11.3.2 Activity 6: Use and Maintenance of Haul Roads

11.3.2.1 Impact Description: Surface Water Quantity

There will be decrease in water quantity reporting to the catchment as the length of the haul roads increases.

11.3.2.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long term	4	Medium-term	3
Scale	Regional	5	Local	3
Severity	Serious medium term	4	Moderate	3
Likelihood	Probable	4	Probable	4
Significance	Medium low	52	Low	27

11.3.2.3 Mitigation Description

It is important to minimise the disturbed area in order to limit the runoff volume that cannot report to the catchment. Well-constructed storm water drains are necessary to effectively direct clean water through the haul road areas to the rest of the catchment.

11.3.2.4 Impact Description: Surface Water Quality

Negative Impacts could arise from dust generated from the use of roads, soil erosion and the ore dust settling on the surface water environment. Pro-longed leaks and spillages on the haul roads could result in water quality deterioration.

11.3.2.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long term	4	Medium term	3
Scale	Municipal	4	Local	3
Severity	Serious midterm	4	Moderate	3
Likelihood	Probable	4	Improbable	2
Significance	Medium low	48	Low	18

11.3.2.6 Mitigation description

Use of dust suppression methods on the roads and regularly maintain haul roads to eliminate erosion is recommended. Maintain level of moisture in the ore and roads during transportation that prevents dust generation. Use the dust covers on truck and oil leak trays. Monthly water quality monitoring is to be conducted on the surface water resources.

11.3.3 Activity 7: Removal of Ore (Mining Process) and ROM Ore Stockpile

11.3.3.1 Impact Description: Surface Water Quantity

There will be decrease in water quantity reporting to the catchment as the pits will capture and contain the rainfall and prevent free flow to the clean catchment. The isolation of dirty areas and stockpiles is isolated from the clean catchment thus less water quantity reporting to the clean catchment.

11.3.3.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project life	4	Medium-term	3
Scale	Regional	4	Local	3
Severity	Very serious	4	Moderate	3
Likelihood	Almost certain	4	Unlikely	3
Significance	Medium low	48	Low	27

11.3.3.3 Mitigation Description

It is important to ensure that once mining has been completed, to backfill the voids and grade the slopes to minimise the water prevented from reporting to the catchment. Pit dewatering should be implemented.

11.3.3.4 Impact Description: Surface Water Quality

Water contamination could result from leaching and toxic drainage of particulates and fines from ROM stockpile and from opencast mining areas.

11.3.3.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project life	5	Medium term	3
Scale	Region	5	Local	3
Severity	Very serious long term	5	Moderate	3
Likelihood	Probable	4	Probable	4
Significance	Medium low	60	Low	36

11.3.3.6 Mitigation description

The use of bunding around the stockpiles to separate clean and dirty water after rainfall events can minimise impacts. Monthly water quality monitoring is to be conducted on the surface water resources.

11.3.4 Activity 8: Water Use & Storage on Site

The water uses in the mining process includes screening and washing as well as storage in the PCD.

11.3.4.1 Impact Description: Surface Water Quantity

There will be decrease in water quantity reporting to the catchment due to capturing of contaminated water in the of water in PCDs. The clean and dirty water separation reduces the clean water flowing to the catchment.

11.3.4.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project Life	5	Short term	2
Scale	Regional	5	Local	3
Severity	Moderate short term	3	Moderate	3
Likelihood	Likely	4	improbable	2
Significance	Medium low	52	Low	16

11.3.4.3 Mitigation Description

Recycle water used and encourage effective water treatment thus clean water is released to the clean catchment where possible.

11.3.4.4 Impact Description: Surface Water Quality

Seepage of dirty water to the natural streams and accidental spillages from PCDs and flooding of PCDs in extreme rainfall events could result in surface water quality contamination. The impacts of deteriorated water entering the surface water resources will result in a stressed catchment particularly the most vulnerable water users. Mine water as a result of underground mining could also introduce contaminated water to the surface water quality.

11.3.4.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Permanent- Mitigation	6	Project Life	5
Scale	Regional	5	Region	5
Severity	Significant	6	Moderate	3
Likelihood	Likely	5	Unlikely	3
Significance	Medium low	65	Medium low	39

11.3.4.6 Mitigation description

No activities to take place within 100 m from a water resource or inside the 1: 100 yr floodline. There has to be strict adherence to health and safety and the risk assessment that need to be conducted regularly. The PCD constructed should be adequately lined to prevent the leaching into the ground and should also have adequate capacity to contain a 1: 50 year 24 hr flood volume based on the peak flows determined.

11.3.5 Activity 9: Storage, Handling and Treatment of Hazardous Products (Fuel, Explosives, Oil) and Waste Activities (Waste, Sewage, Discard, PCD)

11.3.5.1 Impact Description: Surface Water Quantity

There will be decreased water quantity reporting to the catchment as storage areas are isolated from the rest of the catchment.

11.3.5.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project Life	5	Medium-term	3
Scale	Regional	5	Local	3
Severity	Moderate	3	Moderate	3
Likelihood	Unlikely	3	Unlikely	3

Significance	Medium low	39	Low	27

11.3.5.3 Mitigation Description

It is important to minimise the storage area by utilising few designated areas and bring in chemicals on site only when they need to be used.

11.3.5.4 Impact Description: Surface Water Quality

Negative impacts could arise from hazardous substances spillages and prolonged and continuous leakages from the storage facilities and from PCDs.

11.3.5.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Permanent- No Mitigation	7	Medium term	3
Scale	National	6	Local	3
Severity	Very serious	5	Moderate	3
Likelihood	Probable	4	Unlikely	3
Significance		72	Low	27

11.3.5.6 Mitigation Description

Ensure that storage areas are on hard park areas with bunding to hold spillages, access control to storage areas, allow only trained and authorized personnel to handle hazardous materials, employ on accredited contractors for the removal of hazardous waste, all vehicles to be fitted with oil leak trays, regulated sewer treatment and disposal facilities PCDs and on-going monitoring of surface water resources (weekly and monthly during construction and operation respectively).

11.3.6 Activity 10: Concurrent Replacement of Overburden, Topsoil and Re-vegetation

11.3.6.1 Impact Description: Surface Water Quantity

There will be neutral impacts arising from the replacement and vegetation of project area as some of the runoff is returned to catchment. These impacts are neutral because the catchment hydrologic response can be restored to a state close to what it was before the project but never to the original state.

11.3.6.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project Life	5	Medium -term	3
Scale	Regional	5	Local	4
Severity	Moderate	3	Moderate	3
Likelihood	Probable	4	Unlikely	3
Significance	Medium low	52	Low	30

11.3.6.3 Mitigation Description

Maximise the positive impacts by monitoring the replacement of overburden and the revegetation process so that more clean free flowing water drains to the catchment

11.3.6.4 Impact Description: Surface Water Quality

Water quality deterioration could result from toxic overburden and from improper handling of the re-vegetation process resulting in siltation from soil erosion.

11.3.6.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Permanent- Mitigation	6	Project Life	5
Scale	Regional	5	Local	3
Severity	Significant	4	Serious medium term	4
Likelihood	Likely	5	Unlikely	3
Significance	Medium High	75	Medium low	36

11.3.6.6 Mitigation description

Sediment control should be maintained during revegetation, and toxic overburden should be segregated and treated before being replaced to the area.

11.4 Decommissioning Phase

Decommissioning of the project entails activities such as demolition of infrastructure including the makeshift site offices and workshops as well as temporary sanitary facilities rehabilitation and monitoring of the environment.

11.4.1 Activity 11: Demolition & Removal of all Infrastructure (incl. Transportation Offsite)

11.4.1.1 Impact Description: Surface Water Quantity

There will be more free cleared ground, which could translate into return of some runoff to the catchment.

11.4.1.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Medium term	3	Short term	2
Scale	Regional	5	Regional	5
Severity	Minor effects	2	Moderate	3
Likelihood	Unlikely	3	Improbable	2
Significance	Low	30	Low	20

11.4.1.3 Mitigation Description

On-going rehabilitation and clean up and monitoring of the cleared areas should ensure free drainage to the catchment.

11.4.1.4 Impact Description: Surface Water Quality

Spillage of hazardous substances and hydrocarbon containing material, spillages of material during transportation, dust and erosion form the vehicular movement and the exposed ground respectively could result in water quality deterioration.

11.4.1.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Permanent: Mitigation	6	Medium term	3
Scale	Regional	5	Local	3
Severity	Significant	6	Moderate	3
Likelihood	Probable	4	Unlikely	3
Significance	Medium low	68	Low	27

11.4.1.6 Mitigation Description

Only accredited contractors should be employed to decommission and dispose of the infrastructure at the correct disposal facilities. Dust suppression to be implemented during the decommissioning phase. Water quality monitoring frequency should be increased to weekly. The decommissioned area should be cleaned up to prevent runoff falling on the site to be contaminated. The cleaned up area should be rehabilitated to prevent soil erosion and siltation of the water resources.

11.4.2 Activity 12: Rehabilitation

Rehabilitation is envisaged to include mainly spreading of soil, re-vegetation and profiling/ contouring.

11.4.2.1 Impact Description: Surface Water Quantity

The rehabilitation will result in the return of runoff to the catchment and increased runoff. This is a neutral impact since the catchment can never be returned to the pre-project state.

11.4.2.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long-term	4	Medium term	3
Scale	Regional	5	Regional	5
Severity	Moderate	3	Minor effects	2
Likelihood	Unlikely	3	Improbable	2
Significance	Medium low	36	Low	20

11.4.2.3 Mitigation Description

It should be ensured that there is no damming of storm water but that runoff can freely drain to the catchment and profiling is done by competent personnel.

11.4.2.4 Impact Description: Surface Water Quality

There will be a neutral impact on surface water quality since some of the impacts that occurred during the construction and operational phases will have a cumulative impact on the surface water quality.

11.4.2.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long-term	4	Long term	4
Scale	Regional	5	Local	3
Severity	Moderate	3	Moderate	3
Likelihood	Unlikely	4	Rare	2
Significance	Medium low	48	Low	22

11.4.2.6 Mitigation Description

Water quality monitoring and rehabilitation monitoring must be implemented to ensure that there is no soil erosion that could result in the water quality impacts. The rehabilitated areas have to be vegetated and to reduce soil erosion. Cumulative impacts have to be monitored through a monitoring programme that will last at least three years after decommissioning.

11.4.3 Activity 13: Installation of Post Closure Water Management Infrastructure

11.4.3.1 Impact Description: Surface Water Quantity

Some runoff can be closed off by post closure water management systems..

11.4.3.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long-term	4	Medium term	2
Scale	Municipal area	4	Local	3
Severity	Moderate	4	Moderate	3
Likelihood	Unlikely	3	Rare	3
Significance	Medium low	36	Low	24

11.4.3.3 Mitigation Description

Management should include treatment facilities of the water so that collected water in the post closure can be rechanneled to the catchment when adequately treated to conform to standards.

11.4.3.4 Impact Description: Surface Water Quality

There will be impacts on the surface water in the cases that the installation of post closure water management infrastructure could result in few minor or even major spillages of construction materials as well.

11.4.3.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long-term	4	Long term	5
Scale	Regional	5	Local	3
Severity	Moderate	3	Moderate	2
Likelihood	Improbable	2	Improbable	2
Significance	Low	24	Low	20

11.4.3.6 Mitigation Description

Cumulative impacts have to be monitored through a monitoring programme that will last at least three years after decommissioning. Decant collection points succeeding decant studies should be included in this stage.

11.4.4 Activity 14: Environmental Monitoring and Decommissioning Activities

11.4.4.1 Impact Description: Surface Water Quantity

As much storm water as possible will be allowed to flow back to the catchment after decommissioning. This is a neutral impact since the catchment can never be returned to the pre-project hydrologic state.

11.4.4.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Medium term	3	Medium term	3
Scale	Regional	5	Regional	5
Severity	Moderate	3	Minor effects	2
Likelihood	Probable	4	Rare	2
Significance	Medium low	44	Low	20

11.4.4.3 Mitigation Description

It is important to ensure that in rehabilitation the area is also vegetated to reduce the surface runoff created. It should also be ensured that there is no damming but that runoff can freely drain to the catchment.

11.4.4.4 Impact Description: Surface Water Quality

There will be a neutralised impact on surface water quality since some of the impacts that occurred during the construction and operational phases will still be present in the surface water resources. However monitoring will detect any causes of concern and any water quality issues post mining.

11.4.4.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project life	5	Medium term	3
Scale	Municipal	4	Local	3
Severity	Moderate	3	Moderate	3
Likelihood	Unlikely	3	Rare	2
Significance	Medium low	36	Low	18

11.4.4.6 Mitigation Description

Water quality monitoring and rehabilitation monitoring must be implemented for at least three years after decommissioning.

11.4.5 Activity 15: Storage, Handling and Retreatment of Hazardous Products (Fuel, Explosives, Oil) and Waste Activities (Waste, Sewage, Discard)

11.4.5.1 Impact Description: Surface Water Quantity

There will be decrease in water quantity reporting to the catchment.

11.4.5.2 Impact Assessment

Parameter	Impact	Impact

	Pre-Mitigation		Post-Mitigation	
Duration	Short term	2	Short term	2
Scale	Local	3	Limited	2
Severity	Moderate short term	3	Moderate	3
Likelihood	Probable	4	Unlikely	3
Significance	Low	32	Low	21

11.4.5.3 Mitigation Description

It is important to minimise the storage and handling area in order to limit the runoff volume that cannot report to the catchment.

11.4.5.4 Impact Description: Surface Water Quality

Water quality deterioration from possible spillages during transportation and including discard could flow into the environment.

11.4.5.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Project life	5	Medium term	3
Scale	Municipal	4	Limited	2
Severity	Serious medium term	4	Moderate	3
Likelihood	Probable	4	Rare	2
Significance	Medium low	52	Low	16

11.4.5.6 Mitigation Description

Only accredited contractors should be employed to handle hazardous substances and water quality monitoring frequency should be increased to weekly. Ensure that a clean-up procedures and protocols are carried out immediately after a spillage.

11.5 Post Closure Phase

Post Closure phase of the project entails activities such as rehabilitation and monitoring.

11.5.1 Activity 16: Post-Closure Monitoring and Rehabilitation

11.5.1.1 Impact Description: Surface Water Quantity

As much water as possible will be returned to the catchment and runoff increased when post closure rehabilitation is carried out. This is a neutral impact since the catchment can never be returned to the pre-project state.

11.5.1.2 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long-term	4	Medium term	3
Scale	Regional	5	Regional	5
Severity	Moderate	3	Minor effects	2
Likelihood	Rare	2	Rare	2
Significance	Low	24	Low	20

11.5.1.3 Mitigation Description

It is important to perform surface water quantity monitoring and flow estimations in event of extreme weather events.

11.5.1.4 Impact Description: Surface Water Quality

Neutral impacts result from the monitoring and it will be possible to pick out post closure impacts such as AMD and impacts from decant including identification of new decant points.

11.5.1.5 Impact Assessment

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration	Long Term	4	Project life	5
Scale	Local	3	Local	3
Severity	Moderate	3	Moderate	3
Likelihood	Probable	4	Unlikely	3

Significance	Medium low	40	Low	33

11.5.1.6 Mitigation Description

Ensure that water quality sampling continues at least 3 years post closure especially for decant.

11.6 Impact Assessment Statement

The water environment in which the project will take place is in a relatively pristine state based on the SANS 241 and the WHO, 2011 drinking water quality guidelines. The execution of the project must ensure that there are no/ minimum impacts on the surface water environment particularly in terms of quality which has indicated most significance compared to quantity. The implementation of monitoring as an early impact detection tool must be enforced to ensure that the recommended mitigation measures are implemented in time.

Importantly, the on-going rehabilitation will significantly reduce the significance of the impacts on quality and quantity. This has to be implemented in the prescribed manner (particularly with the backfilling of overburden followed by the different soils).

The most significant impacts identified relate to surface water quality and these have a potential to spread from local to regional extent, thus the execution of the project must be sensitive to the likely potential of these impacts arising. During the execution of the project, it will be imperative that surface water quality monitoring programme should be executed during all stages of the project.

The handling and storage of hazardous substances are most likely to present the most significant impacts. Another noticeable impact can be attributed to erosion in areas where vegetation has been cleared and on stockpiles (ROM, topsoil and overburden). It is also important to ensure that the frequency of monitoring is increased in the construction and decommissioning phases to enable the early detection of negative impacts.

The major surface water risks and findings within the project sub catchments are:

- The most significant impact could result from accidental spillage of hazardous substances (hydrocarbon containing, explosives and sewerage) and the pro-longed spillage of such materials;
- Soil erosion from the topsoil berms used for clean and dirty water separation (particularly in the dry season during construction phase) could result in adverse siltation impacts at the on-set of the raining season;
- Blasting could arise in water quality and quantity impacts as some of the explosives contain nitrates and ammonia and these could result in water contamination. At the same time improper blasting could result in unnecessary cracks in the aquifer bed, thus altering the surface water-groundwater interaction reducing stream flows;

- The mining process (particularly the strip mining methods), crushing and screening and handling of the ROM, topsoil, overburden and excess rock stockpiles could result in water contamination from the generated rock fines and dust;
- The removal of surface infrastructure could result in major and minor accidental spillages/ exposure of areas where there has been pro-longed leaks. Procedures for water management and decommissioning if followed carefully could prevent/ reduce the significance of resultant impacts. Good waste handling and appropriate disposal could reduce these impacts;
- The backfilling, re-vegetation and contouring of mining footprint will result in a neutral impact as it will result in restoring the clean runoff to the catchment once the reclamation and rehabilitation is completed (although he conditions may not be returned to pre-development state); and
- Residual impacts will include the altered hydrology of the sub catchment and the hydrocarbon water contamination which can remain altered even with the construction of closure water management structures.

12 CUMULATIVE IMPACTS

Platinum mining presents negative water quality impacts which emanate from the activities in the form of hard rock waste and other particulate matter impacts. These result in deterioration and alterations of the natural wetlands and streams thus prolonged risk to aquatic life, livestock as well as health risks to humans.

The proposed project area water resources have not yet been negatively impacted upon and the negative impacts from mining will then deteriorate the surface water environment. In order to reduce the deterioration of the water environment, the execution water management strategies and through the implementation of mitigation measures where the impacts arise should be performed.

The most significant impacts relate to the contamination of surface water in the catchment during the operational activities and reduced stream flows through the alteration of the aquifer bed resulting from blasting activities.

Although there will be alteration of the surface hydrology and volume of runoff reporting to the catchment, the minimization of the dirty area will limit the impacts and subsequent contaminated volume of runoff. The backfilling, grading and contouring of the rehabilitated areas should also be implemented to prevent runoff damming and to ensure that the surface runoff reports to the catchment.

13 MITIGATION MEASURES AND MANAGEMENT PLAN

Mitigation measures and management strategies to address the identified impacts are presented in Table 14.

Table 14: Summary of the Impact Mitigation and Management Strategies

Ranking	Impact	Mitigation/ Management measure	Objectives	Frequency of Mitigation	Legal Requirements	Recommended Action Plans	Timing of implementation	Responsible Person	Significance after mitigation
Medium High Risk (107-73)	Water quality deterioration as a result of siltation from soil erosion, dust deposition, accidental spillages of hazardous substances and disposal of wastewater and washing off of rock fines into streams.	Vegetate topsoil isolation berms; Implement dust suppression; Prevent dirty water reaching the surface water resources by isolating clean/ dirty areas; minimize the dirty area; Implement hazardous substances handling procedures;	Prevent water quality deterioration from siltation, waste and hazardous substances.	During construction, operation and decommissioning phases;	NWA; GN R 704; DWA BPGs	Isolate clean and dirty areas with vegetated topsoil berms; Implement dust suppression with water tankers or application of dust suppression chemicals; Training personnel on handling of coal fines on loading to reduce coal breakages into fines; Implement hazardous substances handling procedures; and Daily monitoring of potential risk areas; Undertaking monthly monitoring and	LoM	Environmental Manager and Project Engineer	Medium-Low to Low

Ranking	Impact	Mitigation/ Management measure	Objectives	Frequency of Mitigation	Legal Requirements	Recommended Action Plans	Timing of implementation	Responsible Person	Significance after mitigation
		and prevent spillages into the environment				increasing frequencies when impacts are detected while implementing mitigation measures.			
	Water quantity impacts as a result of the increased surface runoff falling on cleared ground and not allowed to report to the catchment as well as the diverted stream flows from fractures of the aquifer bed and storm water	Minimise the disturbed area; On-going rehabilitation of the mined out areas; Proper blasting techniques to be followed to minimise	To reduce the water quantity that is prevented from reporting to the catchment.	LoM	NWA; GN R 704; DWA BPGs	On-going rehabilitation (minimization of the dirty area) when mining and backfilling; Application of vegetation to ensure that more runoff can report to the catchment; Adhere to the blast patterns and distance from streams to prevent unnecessary	LoM	Environmental manager; Mine Engineer	Low

Ranking	Impact	Mitigation/ Management measure	Objectives	Frequency of Mitigation	Legal Requirements	Recommended Action Plans	Timing of implementation	Responsible Person	Significance after mitigation
	management systems as a result of blasting activities close to streams.	fractures; Contouring; and vegetation of the rehabilitated areas.				cracks and stream diversions when underground operations are underway			
Medium Low(60-39)	Water quality deterioration from dust deposition and pro-longed leaks of construction material and stored hazardous substances.	Implement dust suppression strategies; Ensure trained personnel operate the infrastructure.	Prevent water quality deterioration from dust deposition and construction material spillages	During construction and decommissioning phases	GN R 704; DWA BPGs	On-going implementation of dust suppression; Monitoring of construction and evaluation of training of machine operators.	Construction and decommissioning	Environmental Control Officer and Site Engineer	Low
	Reduced runoff water quantity reporting to the catchment.	On-going rehabilitation and minimization of dirty areas	Minimize the volume that does not report to the catchment.	During construction with daily monitoring throughout the life of the project	GN R 704; DWA BPGs	On-going backfilling and vegetation of the areas as the pipeline is laid; Monitoring for vegetation growth	Construction and life of project	Environmental Control officer and Project Engineer	Low

14 MONITORING PROGRAMME

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented.

14.1 Surface Water Quality

Various water quality variables will be monitored particularly the Variables of Concern (VoC) likely to emanate from mining activities as well as those variable identified in the baseline analyses (Fe). Variables that would need monitoring include Fe, NH_3, SO_4, Cl, NO_3 and EC, and will be monitored on a frequency prescribed by monitoring programme based on the activities (e.g. weekly during construction and decommissioning and monthly during operation). Surface water monitoring will be conducted at strategically identified locations as indicated on Plan 7 (Appendix A).

14.2 Surface Water Quantity

Where possible the water quantity and channels geometry will be monitored in extreme flood events to determine any impact of the mining on river channels and water quantity in general, in the catchment.

14.3 Objectives of Monitoring Programme

The objective of the monitoring plan would be to monitor the impact of the platinum group metals mining, rock waste and its subsequent infrastructure through the continuous analyses of water quality and quantity (where possible).

14.4 Monitoring Frequency

The proposed monitoring programme for surface water quality will be implemented at different frequencies over the duration of the project as follows:

Phase	Variables	Frequency
Construction	All	Weekly
Operation	All	Monthly; and Where negative impacts are detected (spillage) frequency to be increased to weekly until the impacts are cleared.
Decommissioning	All	Weekly

15 CONCULSIONS AND RECOMMENDATION

The following conclusions and recommendations are made on the impact assessment of the platinum group metals mining site.

15.1 Conclusions

The impact assessment conclusions are as follows:

- The most significant impacts could affect the surface water quality of this relatively pristine water environment;
- The handling of hazardous substances and waste substances could result in highly significant impacts as a result of huge spillages or pro-longed leakages;
- The potential of siltation of water resources is likely since there could be soil erosion and dust deposition in the early years of the LoM when open cast mining methods will be employed; and
- Surface water quantity will be impacted upon as the contaminated runoff will not be allowed to report to the catchment.

15.2 Recommendations

It is therefore recommended that the following be taken into consideration:

- Regular monitoring and dust suppression must be carried out in dust producing operations;
- The blasting methods and protocols should be adhered to and monitored;
- The storage and handling of hazardous material must be only by authorized personnel, disposal of the used up material be undertaken by accredited contractors;
- On-going rehabilitation when mining and clearing areas should be carried out minimise the contamination of surface runoff that is prevented to report to the catchment;
- The process of construction should be carried out in the dry season to prevent the erosion and subsequent siltation of surface water resources;
- The surface water management and monitoring plan be adhered to and the responsible personnel should be trained on the contents in order to execute the project with minimum surface water impacts; and
- The management plan must be reviewed on an on-going basis and adapted accordingly to ensure that it stays relevant.

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Appendix A: Plans

Plan 1: Regional Setting

Plan 2: Land Tenure and Mine Plan

Plan 3: Surface Water Resources

Plan 4: Quaternary Catchment Boundaries

Plan 5: Sub-Catchment Boundaries

Plan 6: Surface Water Sampling Points

Appendix B: Declaration of independence

Appendix C: Flood Volume Calculations

Appendix D: Laboratory Data

Appendix E: Water Quality Graphs