Environmental Authorisation and Integrated Water Use Licence Applications for the Proposed Water Treatment Plant at the Klipspruit Colliery, Mpumalanga Province

Surface Water Impact Assessment

Project Number:

SOU5014

Prepared for:

South32 SA Coal Holdings (Pty) Ltd

November 2018

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Report Type:	**Surface Water Impact Assessment**
Project Name:	**Environmental Authorisation and Integrated Water Use Licence Applications for the Proposed Water Treatment Plant at the Klipspruit Colliery, Mpumalanga Province**
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Name	**Responsibility**	**Signature**	**Date**
Mashudu Rafundisani	Report Writer		August 2018
Andre van Coller	OpsCo Review		August 2018

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LIST OF ABBREVIATIONS

Abbreviation	Description
DMR	Department of Mineral Resources
CBE	Charge Balance Error
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
WUL	Water Use License
WTP	Water Treatment Plant
KPS	Klipspruit
km	Kilometre
ℓ	Litre
ℓ/s	Litre per second
ℓ/h	Litre per hour
ML	Mega Litres
magl	metres above ground level
NWA	National Water Act
mbgl	metres below ground level
mg/ℓ	milligrams per litre
mm	millimetre
mm/a	millimetre per annum
ms	milli-seconds
MLD	Mega Litres per Day
RQO	Resource Quality Objectives
SANAS	South African National Accreditation System
TDS	Total Dissolved Solids
WISH	Windows interpretation system for hydrogeologist

1 Introduction

Digby Wells Environmental (hereafter Digby Wells) has been appointed by South32 SA Coal Holdings (Pty) Ltd (hereafter South32) to undertake an Environmental Impact Assessment (EIA) in relation to proposed active water treatment plant capable of treating 10 Mega litres of mine affected water from the balancing dam. South32's Klipspruit Colliery (KPS) is located approximately 3km west of the town of Ogies in Mpumalanga Province. The regional and local setting of the project is shown in Figure 2-1 and Figure 2-2.

The surface water assessment report serves to provide the hydrological baseline description of the project area and the surrounds prior to commencement of project, assess and identify the potential impacts on the surface water resources that could emanate from the proposed project and its associated activities. The report will also provide the appropriate mitigation measures to prevent, minimise and/or reduce the identified potential impacts.

The surface water impact assessment study is undertaken in line with the Department of Water and Sanitation (DWS) Best Practice Guideline for Impact Prediction and is guided by following legislative requirements:

- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- Regulation 636 under the National Environmental Management: Waste Act;
- National Water Act (Act 36 of 1998) (NWA) and Government Notice Regulation 704 (GN R 704) of 1999.
- The National Environmental Management Act (Act 107 of 1998): 2017 amendments to the Environmental Impact Assessment (EIA) Regulations.

1.1 Project Background and Description

KPS requires an active WTP capable of treating 10Ml/day of mine affected water from the balancing dam (Figure 2-3). The WTP is to be established within the operational area of the mine in the south-eastern corner of the Mining Right boundary, adjacent to KPS project offices. The proposed WTP will be modular in design and constructed in three phases, starting at a capacity of 2Ml/day, upgradeable to 3.3Ml/day and then increments of 3.3Ml/day to 10Ml/day. Contaminated water will be abstracted from the Balancing Dam at KPS and pumped to the WTP. After treatment, clean water that complies with the Resource Water Quality Objectives (RWQO) for the Wilge River catchment is proposed to be discharged into the Saalklapspruit at the northern boundary of the KPS operation adjacent to the N12 national highway.

The treatment process will be based on the use of membrane desalination with brine softening and will consist of the following steps:

- Pre-treatment of the feed water using pH adjustment and disinfection to remove organics from the system that can cause fouling and scaling of the membranes;

- Removal of the dissolved metals by chemical oxidation followed by the removal of precipitates and suspended solids using flocculation and coagulation unit processes;
- Ultrafiltration (UF) will be used to remove fine particles from the feed water to the Reverse Osmosis (RO) unit processes. This is necessary to prevent fouling and scaling of the RO membranes; and
- Product water conditioning is required to ensure the pH meets the discharge requirements.

This process will produce gypsum sludge and brine. The gypsum sludge will be dewatered at the WTP and then loaded onto trucks for off-site disposal at a licenced waste management facility designed for this type of material. The brine will be recycled back into the treatment process until the salinity requires that a portion be depleted from the system. This small volume of brine will be stored in tanks within the proposed WTP footprint from where it will be pumped into road tankers and transported to a third-party waste management site licenced to receive this waste.

The infrastructure layout of the project is depicted in Figure 2-3 and the key infrastructure components of the project scope are as follows:

- A Feed Water Line comprising of a pump station and 1.5km High Density Poly Ethylene (HDPE) pipeline from the Balancing Dam to the WTP site capable of pumping 10Ml/day;
- A return water system from the WTP to the Balancing Dam along the same route as the Feed Water Line for the management of treated water that does not comply with the requirements for release to the catchment;
- A WTP Area with a footprint of approximately 1.5ha for the establishment and operation of a modular WTP with a maximum throughput of 10Ml/day. This includes the development and use of facilities for the storage and handling of hazardous chemicals used in the treatment process;
- A Discharge Line comprising of a 4km HDPE pipeline along the eastern boundary of KPS to transfer the treated water for discharge to the Saalklapspruit. Two pipeline routes are required to accommodate advancing mining and rehabilitation activities along the proposed pipeline servitude, and will be implemented at different stages of the project; and
- A dissipation structure at the proposed discharge point, alongside the N12 National Highway.

Supporting services such as the new powerline and change houses and ablution facilities (connected to KPS's existing sewage line) are also included in the project.

1.2 Aims and Objectives

The aims and objectives of this surface water assessment in the Scoping Phase were to identify the baseline hydrological description and identify potential impacts. The impact assessment phase comprised of a detailed characterisation of the baseline hydrology, floodlines delineation, a mine water balance which considers the WTP, and a detailed impact assessment. The methodology applied for this study is discussed in further detail in the section below.

2 Details of the Specialist

This Specialist Report has been compiled by the following specialists:

Table 2-1: Details of the Specialist(s) who prepared this Report

Responsibility	**Report Writer**
Full Name of Specialist	Mashudu Rafundisani
Highest Qualification	Environmental Management (Hons)
Years of experience in specialist field	6
Registration(s):	South African Council for Natural Scientific Professionals: Professional Natural Scientist (Reg. No: 115066)
Responsibility	**Technical Review**
Full Name of Specialist	Andre van Coller
Highest Qualification	MSc Geohydrology
Years of experience in specialist field	10

2.1 Declaration of the Specialist

I, Mashudu Rafundisani, as the appointed specialist, hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent, other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity;
- in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any the requirements may result in disqualification;
- have disclosed/will disclose, to the applicant, the Department and interested and affected parties, all material information that have or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application; and

- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.

Signature of the specialist

Mashudu Rafundisani

Full Name and Surname of the specialist

Digby Wells Environmental

Name of company

August 2018

Date

2.2 Methodology

This section provides the methodology for undertaking the baseline hydrology assessment.

2.2.1 Scoping Phase

The scoping phase included the following:

- Desktop review of existing literature on the area, as well as an assessment of aerial imagery;
- Identification and characterisation of all surface water features (rivers/streams, pan and dams) that could potentially be affected by the proposed mine within and around the project area; and
- To determine and describe the hydrological baseline conditions prior to the onset of the Project. This includes description of the affected catchment characteristics, climate (rainfall and evaporation) and topography.

2.2.2 Environmental Impact Assessment Phase

The impact assessment phase includes the following:

2.2.2.1 Detailed Baseline Hydrology

The baseline hydrology characterisation includes an analysis and interpretation of surface water quality obtained from the laboratory. Water samples were collected and sent to an accredited laboratory (Aquatico) for analysis. Water quality results were compared to the existing baseline quality and the River Water Quality Objectives (RWQO) for the Wilge River Catchment to determine the water quality trends and current status.

2.2.2.2 Water Balance

A water balance was prepared according to the DWS Best Practice Guideline G2: Water and Salt Balances. South32 intends to treat and discharge water into the natural stream. An existing mine-wide water balance was updated to reflect volumes of water to be treated and discharged into the stream. An excel based water balance was developed to cater for this, which provides the expected volumes of water to be treated and discharged, mine wide water inflows, outflows and losses within the mine.

2.2.2.3 Floodlines Determination

The 1:100 year floodlines on the Saalklapspruit were delineated in 2009 during the Environmental Management Programme (EMP) studies undertaken by SRK. This has been updated taking into consideration the proposed discharge volumes from the WTP. Floodlines modelling comprises the following main tasks:

- Undertake a hydrological assessment to determine the 1:100 year peak flows;
- Prepare geometric data for input into the HEC-RAS 4.1.0 model using HEC-GeoRAS 10.2;
- Undertake hydraulic modelling using the HEC-RAS 4.1.0 to determine the 1:100 floodlines;
- Import HEC-RAS results into HEC-GeoRAS 10.2 and perform flood inundation mapping to produce the 1:100 year floodlines; and
- Submit a report with a plan indicating the 1:100 year floodlines and a 100 m buffer, as well as a discussion of the results together with the recommendations.

2.2.2.4 Impact Assessment

Potential surface water (quality and quantity) impacts that may result from the proposed project activities, based on the established baseline conditions, have been identified. Thereafter, a numerical environmental significance rating process that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a particular environmental risk is undertaken. Mitigation measures are then determined for implementation to prevent and/or reduce the identified potential surface water impacts.

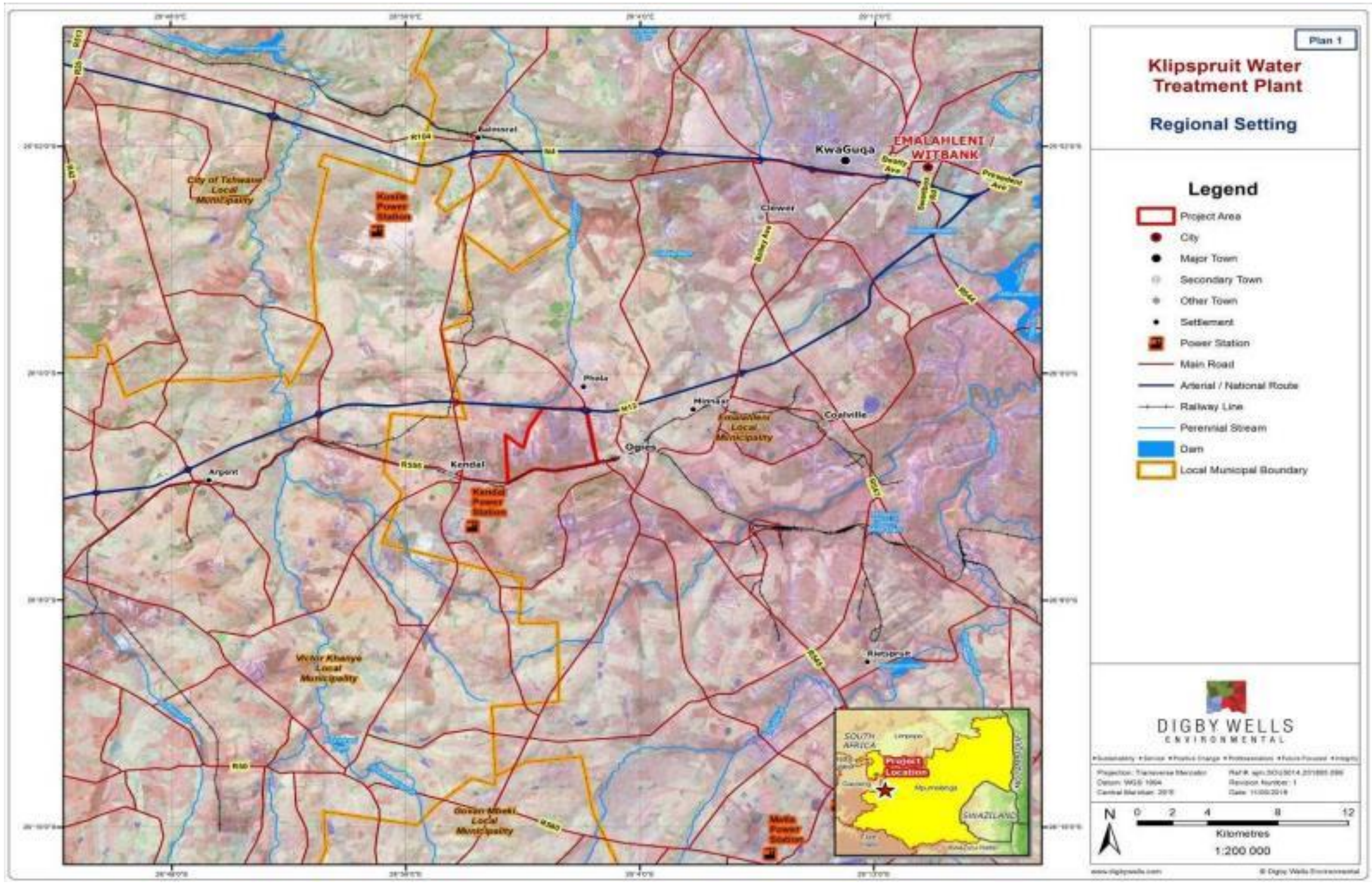

Figure 2-1: Regional Setting

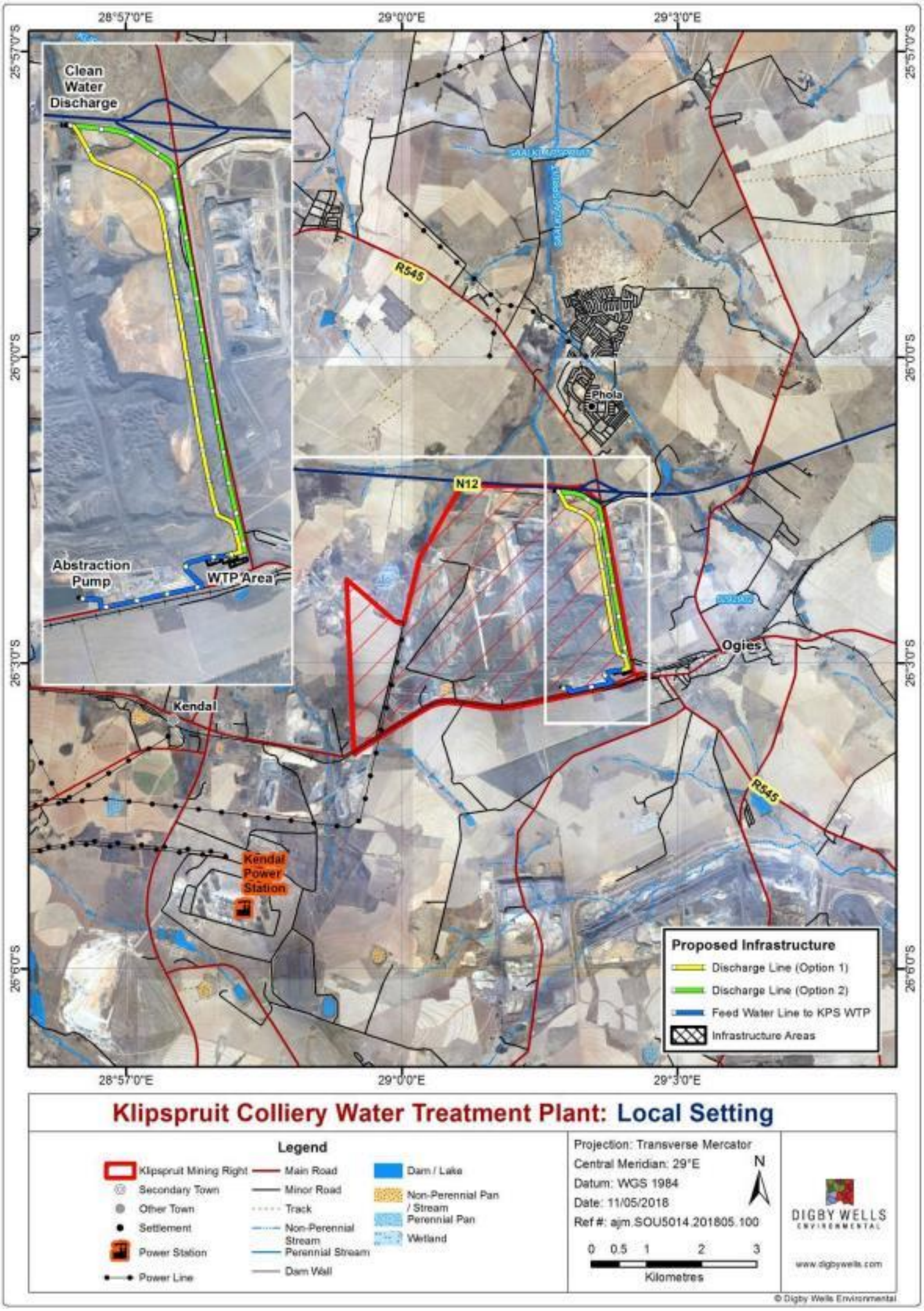

Figure 2-2: Local Setting

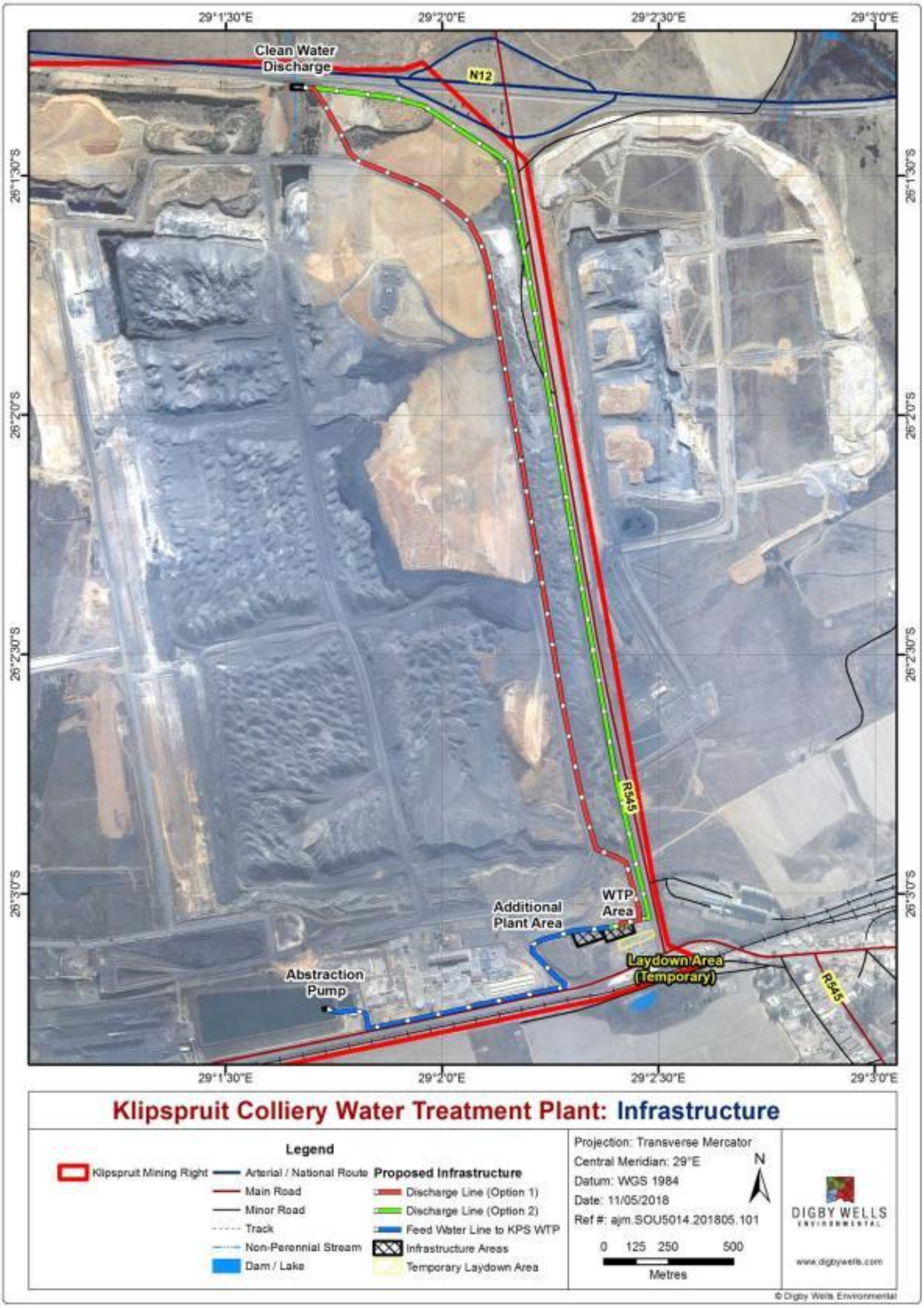

Figure 2-3: Infrastructure Layout

3 Assumptions and Limitations

The following are assumptions and limitations for this study:

- Historical water quality results for the site were provided to Digby Wells by South32 and this is assumed to be correct historical water quality data representation of the site;
- The floodlines were developed for environmental and indicative purposes only and not for engineering design; and
- It is assumed that the survey data provided by the client is an accurate and up-to-date representation of the ground level terrain.

4 Baseline (Desktop) Analysis

4.1 Hydrological Setting

This section provides the hydrological baseline description. This includes description of the water management areas (WMAs), rivers and drainages, climate (rainfall and evaporation), and water quality status within or around the project area.

4.1.1 Regional Hydrology

South Africa is divided into 9 Water Management Areas (WMA) (Revised National Water Resource Strategy, 2012), managed by their own water boards. Each of the WMAs is made up of quaternary catchments which relate to the drainage regions of South Africa, ranging from A to X (excluding O). These drainage regions are subdivided into four known divisions based on size. For example, the letter A represents the primary drainage catchment; A2 for example will represent the secondary catchment; A21 represents the tertiary catchment and A21D would represent the quaternary catchment which is the lowest subdivision in the Water Resources of South Africa, 2012 manual. Each of the quaternary catchments has associated hydrological parameters.

The project area is located in the Olifants Water Management Area 2 (WMA 2), with the proposed WTP footprint and associated pipeline falling in quaternary catchments B20G, this quaternary catchment lies in the greater Wilge River Catchment, which is upstream of the Loskop Dam Catchment. The quaternary catchments are shown in Figure 4-1.

Table 4-1 present the surface water attributes of the B20G quaternary catchment namely Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR), and Mean Annual Evaporation (MAE) were obtained from the Water Resources of South Africa 2012 Study (WR2012), these manuals have data from 1920 to 2009 which is sufficient to calculate or model the mean or average climate data for specific sites:

Table 4-1: Summary of the surface water attributes of the B20G quaternary catchment

Quaternary Catchment	Catchment Area (km^2)	Rainfall Zone	MAP (mm)	MAR (mm)	MAR $m^3 x 10^6$	Evaporation Zone	MAE (mm)
B20G	519.4	B2C	669	44.0	22.87	4A	1689

Water Resources of South Africa 2012 Study

4.1.2 Rivers and Drainages

The proposed WTP footprint and associated pipeline are located within the KPS mining area which is situated on the south west boundary of the B20G quaternary catchment. This catchment is characterised by several streams in the upper reaches of the Olifants River system.

The mine is located just upstream of where the Saalklapspruit originates and surface runoff from the site joins the Saalklapspruit and flows in a northerly direction to join the Wilge River which eventually joins the Olifants River at the outlet of the quaternary catchment.

There are number of unnamed drainage lines that are tributaries to the Saalklapspruit downstream of the project site before its confluence with the Wilge River. Treated water is proposed to be discharged at the Saalklapspruit.

4.1.3 Topography

The topography of the B20G quaternary catchment and surrounds is undulating with numerous ridges and valleys. The topographical model indicates that the elevation of the project area decreases from 1,612 metres above mean sea level (mamsl) in the south to 1,482 mamsl in the north. The majority of the project area has gentle slopes of less than 4°. Isolated slopes of between 4° and 11.3° occur along the sides of the ridges and river valleys. There is a ridge running in an east-west direction in the southern part of the project area (Digby Wells, 2017).

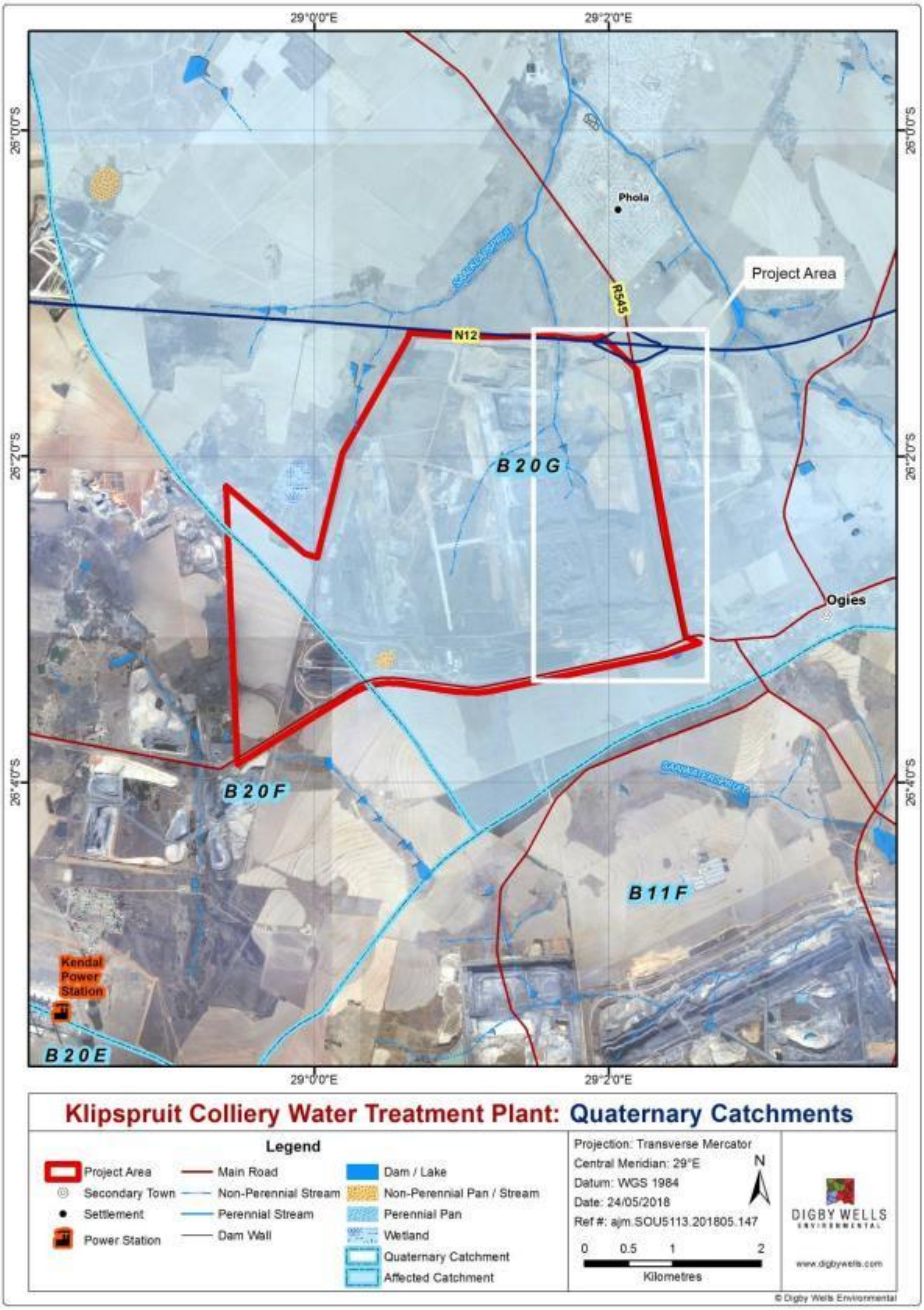

Figure 4-1: Hydrological Setting

4.1.4 Climate

The project area falls in a summer rainfall region, with hot summers and cold dry winters. Temperatures range from 6ºC in winter to 32ºC in summer. This section provides the climatic conditions (temperature, rainfall and evaporation) of the project area.

4.1.4.1 Rainfall

Table 4-2 present the average monthly rainfall for the quaternary catchment B20G. This is based on the averages of monthly rainfall data from a period of 1920 to 2009. Figure 4-2 below present the summary of the average monthly climatic data for B20G quaternary catchment.

Table 4-2: Summary of rainfall data extracted from the WR2012

Month	MAP (mm)
January	122
February	91
March	84
April	41
May	16
June	8
July	6
August	6
September	20
October	68
November	112
December	113
MAP	**686**

From the rainfall data above, higher rainfall values (112 mm, 113 mm and 122 mm) were recorded for the months of November, December and January respectively whilst the lowest rainfall was recorded in July and August (6 mm).

4.1.4.2 Evaporation

Monthly evaporation data was obtained from the WR2012 manual. The project area lies within quaternary catchments B20G, which has a MAE of 2,750mm. The evaporation obtained is based on Symons Pan evaporation measurements and needs to be converted to lake evaporation. This is due to the Symons Pan being located below the ground surface and painted black which results in the temperature in the water being higher than that of a natural open water body. The Symons Pan figure is then multiplied by a lake evaporation factor to obtain the adopted lake evaporation figure which presents the monthly evaporation rates of a natural open water body. This was calculated to be a total average of 2315mm per annum. Table 4-3 is a summary of the evaporation for the B20G quaternary catchment.

Table 4-3: Summary of evaporation data

Months	Symons Pan Evaporation (mm)	Lake Evaporation Factor	Lake Evaporation (mm)
January	180.8	0.81	146.4
February	170.6	0.82	139.9
March	187.8	0.83	155.9
April	184.5	0.84	155.0
May	153.8	0.88	135.3
June	151.8	0.88	133.6
July	116.7	0.88	102.7
August	98.3	0.87	85.5
September	79.8	0.85	67.9
October	87.4	0.83	72.5
November	115.7	0.81	93.7
December	149.9	0.81	121.4
Total	**1677**	**N/A**	**1410**

In this area, higher evaporation rates are experienced during the months of January, March and April whilst the low evaporation occurs in August, September and October. The potential average annual evaporation rate of 1410mm is higher than the average annual precipitation rate of 686 mm. This area is thus a semi-arid area.

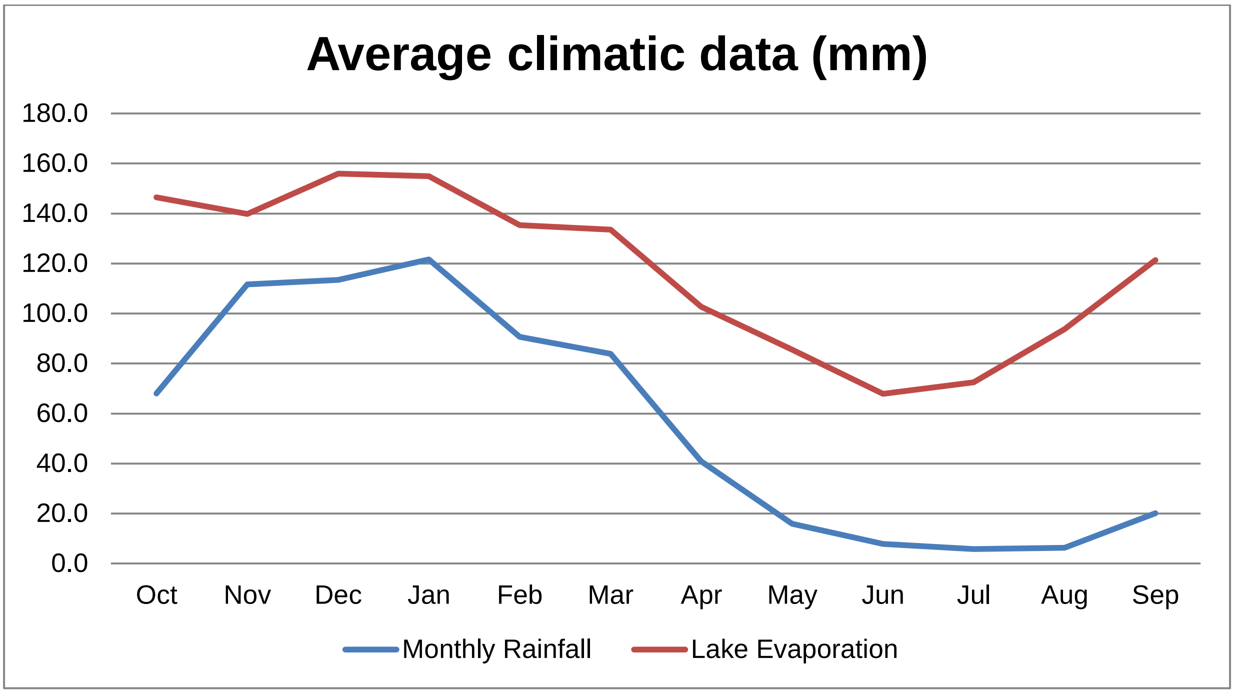

Figure 4-2: Summary of the average monthly climatic data for B20G quaternary catchment

4.1.5 Temperature and Precipitation

The temperature and precipitation data was obtained from previous studies undertaken for KPS (Digby Wells, 2016a). A three-year (2011-2013) average maximum, mean and minimum temperatures for the local area are displayed in Table 10-2. The average daily maximum temperatures range from 8.1°C in June to 21°C in February. Annual mean temperature is given as 14.8°C. The highest temperature recorded for the project site was 30.2°C, with the lowest recorded temperature of -1°C.

Table 4-4: Average Monthly Minimum, Maximum and Mean Temperature Values (Modelled Data, 01 January 2011 to 31 December 2013)

Temp (°C)	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Monthly Maximum	20.4	21.0	19.7	14.6	12.2	8.1	9.2	11.9	14.4	17.7	19.6	20.1	**15.74**
Monthly Minimum	20.0	19.1	18.7	14.2	11.9	8.1	7.4	10.4	14.0	17.2	19.3	19.9	**15.02**
Monthly Mean	20.2	20.0	11.9	14.4	12.1	8.1	8.3	11.2	14.2	17.4	19.5	20.0	**14.78**

The three-year (2011 to 2013) annual total and mean precipitation for the area are 1 064.9 mm and 795.3 mm respectively, as displayed in Table 10-3. The highest monthly maximum precipitation was recorded at 228 mm for December and decreases to 4.1 mm in June. The monthly minimum precipitation ranges between 0 mm in May and July to 192 mm recorded in December.

Table 4-5: Average Monthly Precipitation (Modelled Data, 01 January 2011 to 31 December 2013)

Precipitation (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Monthly Maximum	153.7	115.1	70.9	70.6	20.8	4.1	13.0	17.3	53.1	178.3	140.2	228.1	**88.75**
Monthly Minimum	149.1	45.7	32.8	19.3	0.0	1.3	0.0	8.6	6.6	33.0	98.8	192.0	**48.94**
Monthly Mean	151.4	80.4	20.8	45.0	10.4	2.7	6.5	13.0	29.8	105.7	119.5	210.1	**66.26**

4.1.6 Streamflow Evaluation

There are no streamflow measuring stations along the Saalklapspruit and the surrounding Grootspruit and Tweefonteinspruit. The Saalklapspruit is considered as an ephemeral stream as it does not flow throughout the entire year. However, during the 2014 site assessments done by Digby Wells, flow measurements were taken using a flow meter to obtain the average velocity of the Saalklapspruit when there is flow. The average flow on the downstream section of Saalklapspruit was measured to be 0.1 m/s, with the maximum flow estimated to be 0.2 m/s.

4.1.7 24 Hour Design Rainfall

The WR2012 study provides the mean annual rainfall for specific quaternary catchments, to estimate the site specific 24-hour rainfall depth for different rainfall return periods, a Design Rainfall Estimation programme (DRE) was used (South African software by Smithers and Schulze, 2003). The software obtains data from the South African Weather Services (SAWS) rainfall database using data from 6 rainfall stations within a 20 km radius. The closest rainfall stations are summarised in Table 4-6.

Table 4-6: Summary of the Closest Rainfall Stations to Ogies

Station Name	SAWS Number	Distance (km)	Lat (°)	Lon (°)	MAP (mm)	Altitude (m)
Cologne	0478008_W	8	-26.116667	29.016667	1567	1741

Station Name	SAWS Number	Distance (km)	Lat (°)	Lon (°)	MAP (mm)	Altitude (m)
Bombardie Estate	0478039_W	12.7	-26.166667	29.033333	1570	1742
Ogies (POL)	0478093_W	0	-26.050000	29.050000	1563	1743
Waterpan	0515270_W	12.1	-26.000000	29.150000	695	1605
Clydesdale	0515266_W	16.6	-25.933333	29.150000	768	1606
Clewer (SAR)	0515234_W	18.5	-25.900000	29.133333	724	1525

The software uses the rainfall data to calculate or model the 24-hour design rainfall depth for various rainfall return periods (Table 4-7) using DRE in South Africa (Smithers and Schulze, 2003).

Table 4-7: Calculated 24 Hour Design Rainfall Depth

Design rainfall return period (yrs.)	1:2	1:5	1:10	1:20	1:50	1:100	1:200
24 Hr design peak rainfall (mm)	61.3	82.2	97.2	112.5	133.7	150.6	168.5

Rainfall of 133.7mm in a period of 24 hours is expected as the 1:50 peak rainfall. When compared to the modelled monthly rainfalls, the 24-hour rain exceeds the average monthly rainfall as indicated in Table 4-2.

4.2 Land and Surface Water Use

On a more regional scale, the Wilge River catchment is more rural in nature with the main activity being agriculture around the towns of Bronkhorstspruit and Delmas (DWAF, 2009). The coal mining, previously concentrated in the Middelburg and Witbank Dam catchments is expanding into the Wilge River Catchment. Irrigation agriculture is dominantly practiced within this catchment with the largest irrigation areas located downstream of Loskop Dam.

The predominant users of the surface water resources within the project catchments can be generalised as agricultural and mining.

5 Water Quality

Water quality monitoring at KPS and the surrounding areas commenced in 2004. Digby Wells undertook a site visit in March 2018 to collect water samples at selected strategic monitoring points along the streams to ensure the determination of the current baseline water quality status is for locations that are likely to be impacted by the proposed discharge. The samples were submitted to a South African National Accreditation System (SANAS) accredited laboratory for analyses of physical and chemical water quality parameters. Co-ordinates of these monitoring points are provided in Table 5-1 and the locations are shown in Figure 5-1.

To determine the baseline water quality status and water quality trends, available water quality data was benchmarked against the Resource Quality Objectives of Water Resources for the Olifants Catchment (No.466, 22 April 2016). The project area is located at Wilge sub-catchment and is classified as class II on the Integrated Units of Analysis (IUA) for the Olifants Catchment (class II indicating moderate protection and moderate utilization of rivers within this sub-catchment). These water quality results have been described and interpreted in Section 5.1.

Table 5-1: Coordinates Surface Water Monitoring Locations

Name	Latitude	Longitude	Reason
N12 Discharge Canal 1/ SW-WTP1	26° 1'16.62"S	29° 1'38.21"E	Immediate downstream of the western boundary of the mine along the N12.
SOUSW1	26° 1'21.66"S	29° 3'7.25"E	Tributary to Saalklapspruit far east of the mine
WelSW7/K17	26° 0'21.25"S	29° 1'33.23"E	Saalklapspruit monitoring point downstream of Canal 2 point. Phola Bridge upstream of Phola settlement.
WelSW8	25°58'4.24"S	29° 1'38.16"E	Most downstream point of the Saalklapspruit, bridge downstream of Phola Settlements
N12 Discharge Canal 2	26° 1'18.03"S	29° 0'42.35"E	Immediate downstream of the Eastern boundary of the mine along the N12. Proposed Discharge point

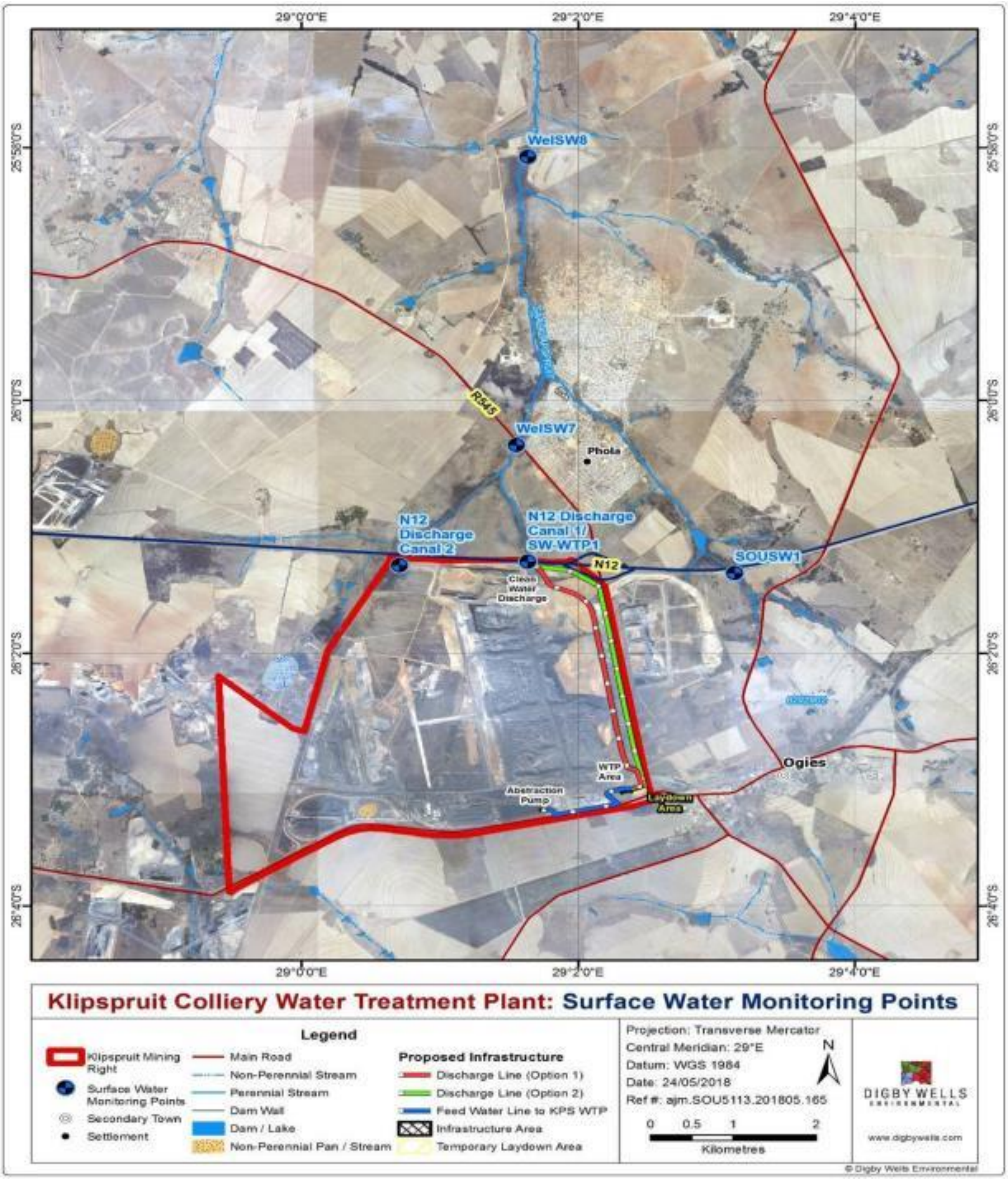

Figure 5-1: Water Quality Monitoring Locations

5.1 Water Quality Results and Chemistry

This section provides the baseline water quality status of the surrounding streams as benchmarked with the RWQO for the Catchment. The duration over which the various data sets were collected influenced the presentation of these results. Based on the availability of data, N12 discharge canal 1/SW-WTP1 (hereafter canal 1/SW-WTP1) and N12 discharge canal 2 (canal 2) were grouped into one section whereas SOUSW1, WelSW7/K17 and WelSW8 formed another group. Amongst the parameters with set limits for the Olifants (class II Wilge River catchment area), only water quality data for Sulphates (SO4), Fluoride (F), Aluminium (Al), and Manganese (Mn) was available, these parameters were used to describe the current and historical water quality for the Saalklapsruit. Other parameters (mostly metals) which has not been analysed as part of the existing monitoring programme have included on the updated/proposed monitoring programme on this report.

Water quality trends for canal 1 and canal 2, benchmarked with the Olifants-Wilge RWQO are shown on Figure 5-2 to Figure 5-5 respectively.

Sulphate levels have mostly been fluctuating within the Olifants-Wilge RWQO with the exception of late 2016 where elevated levels have been observed at Canal 2 monitoring point. A decline in the levels was observed in the middle of 2017 and the recent monitoring shows levels that are within the Olifants-Wilge RWQO. A decrease or downward trend has been observed on the recent water quality for both Canal 1 and 2.

Fluoride levels are within the objective limits throughout the monitoring period between 2014 until recently in July 2018. An observed spike on Canal 1 graph may possibly be an error during data recording. This is evident by the uniform graph or levels of Fluoride that are observed throughout this period. Although there are some periods of volatile fluctuations which exceed the Olifants RWQO for Aluminum, it has been within the limits for a period of 2 years until recently in July. Manganese has also been fluctuating below and above the Olifants RWQO throughout the monitoring period, however, the recent months have shown improvement on manganese levels which is below the Olifants RWQO.

Generally, disruption of coal strata during mining accelerates pyrite oxidation by exposing surface areas of the reactive mineral to weathering. Acidic mine water in a coal mines are mostly related to this process and the water is usually characterized by low pH, high sulphate, and hardness and lower iron (L. Zaihua et al.). Although pH limits are not provided on the Olifants RWQO, pH trend graph was plotted to give an indication of any potential contamination from the mine. The pH of pure water is 7 and the normal range for pH in surface water systems is 6.5 to 8.5, whilst the pH for groundwater systems ranges between 6 and 8.5. Based the pH trend on Figure 5-5 , there is indication of mine water contamination at these two monitoring points.

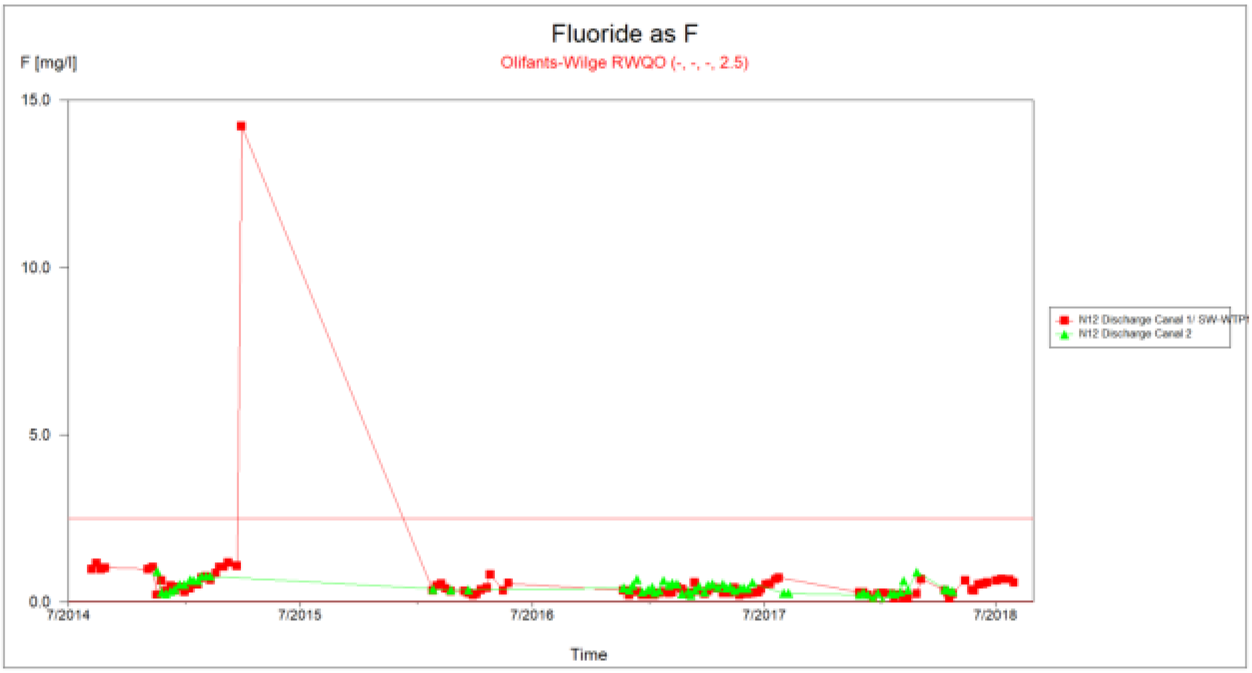

Figure 5-2: Fluoride water quality trend for discharge canal 1/SW-WTP1 and discharge canal 2 sampling points

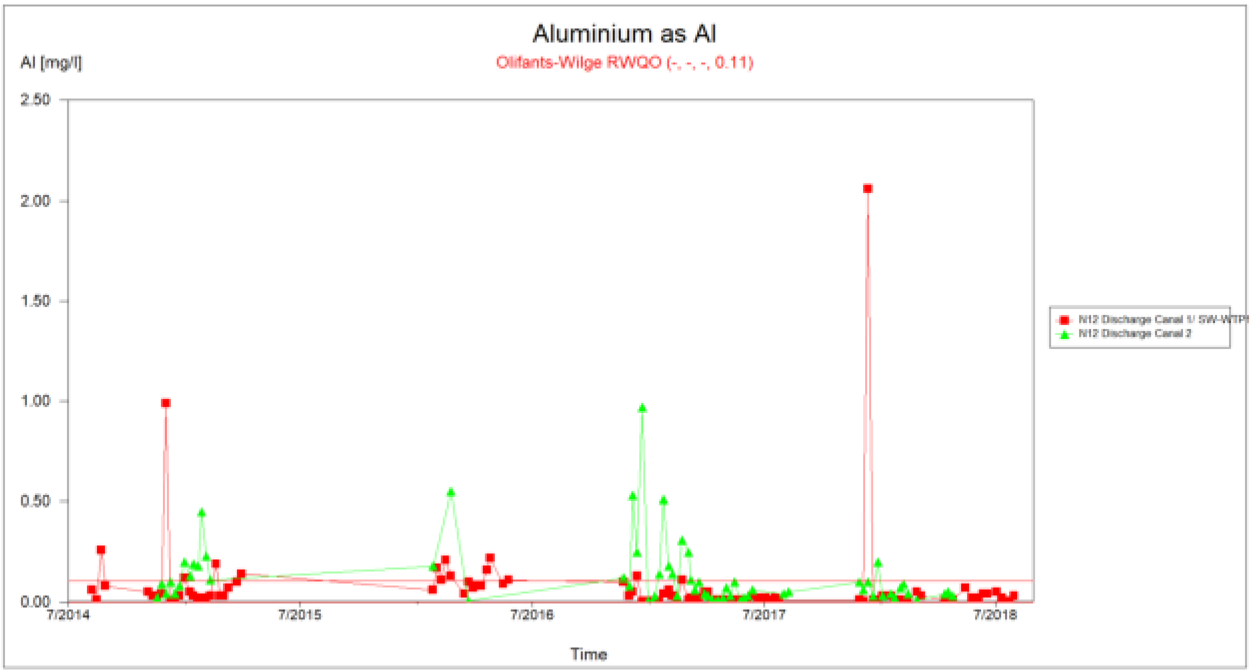

Figure 5-3: Aluminium water quality trend for discharge canal 1/SW-WTP1 and discharge canal 2 sampling points

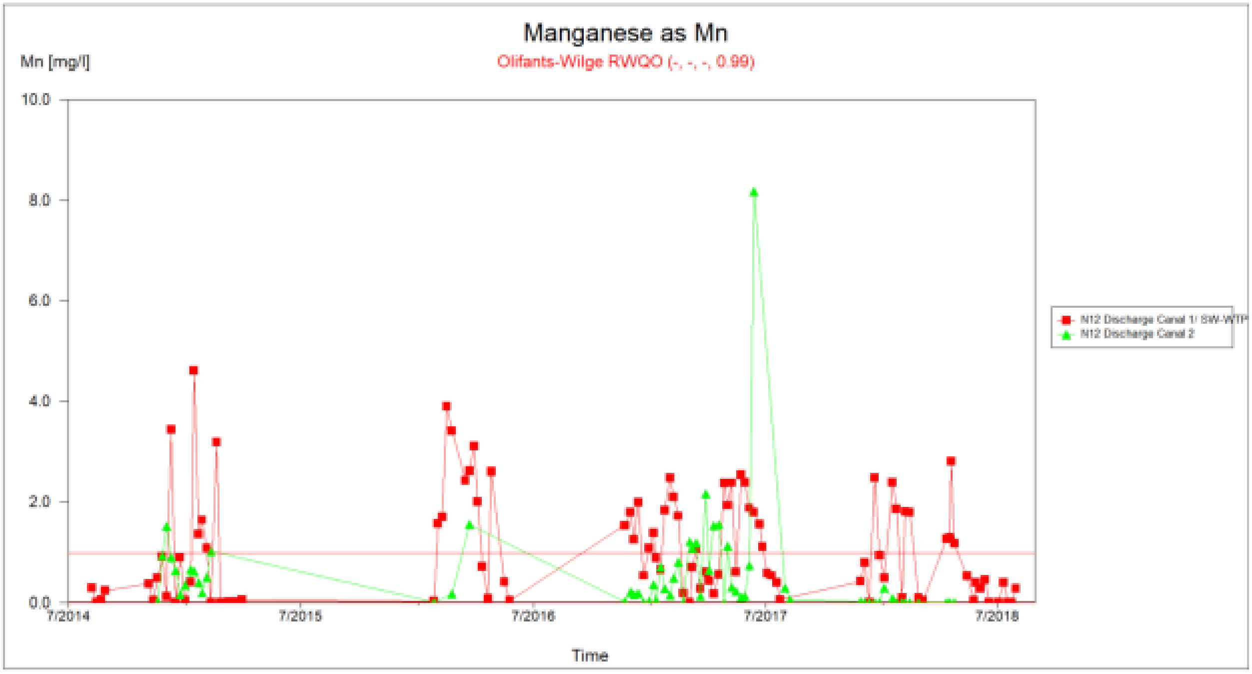

Figure 5-4: Manganese water quality trend for discharge canal 1/SW-WTP1 and discharge canal 2 sampling points

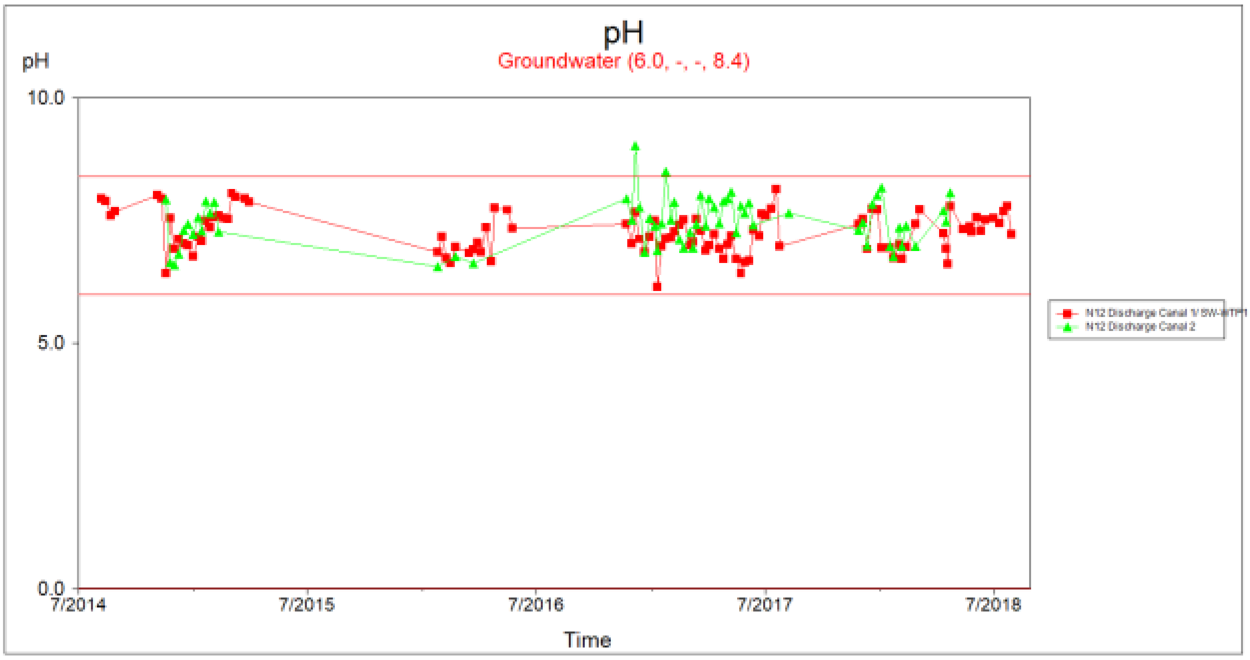

Figure 5-5: pH water quality trend for discharge canal 1/SW-WTP1 and discharge canal 2 sampling points

Water quality results for other monitoring points (SOUSW1, WelSW7/K17 and WelSW8) also show fluctuating trends of Aluminium and Sulphate. Elevated Aluminium levels which exceed Olifant-Wilge RWQO were observed from 2015 until beginning of 2017, the same trend was also observed on Sulphate levels. However, the two parameters have shown great improvement on the recent water quality results and currently within the Olifant-Wilge RWQO.

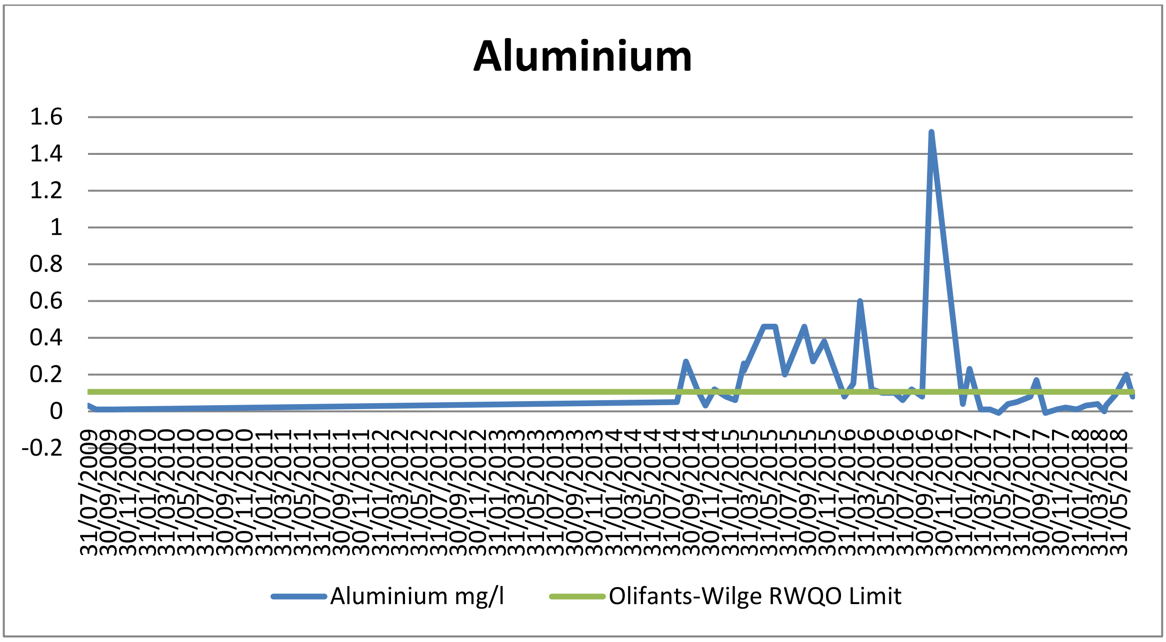

Figure 5-6: Aluminium trend at the downstream monitoring location (WelSW7/K17-Phola Bridge)

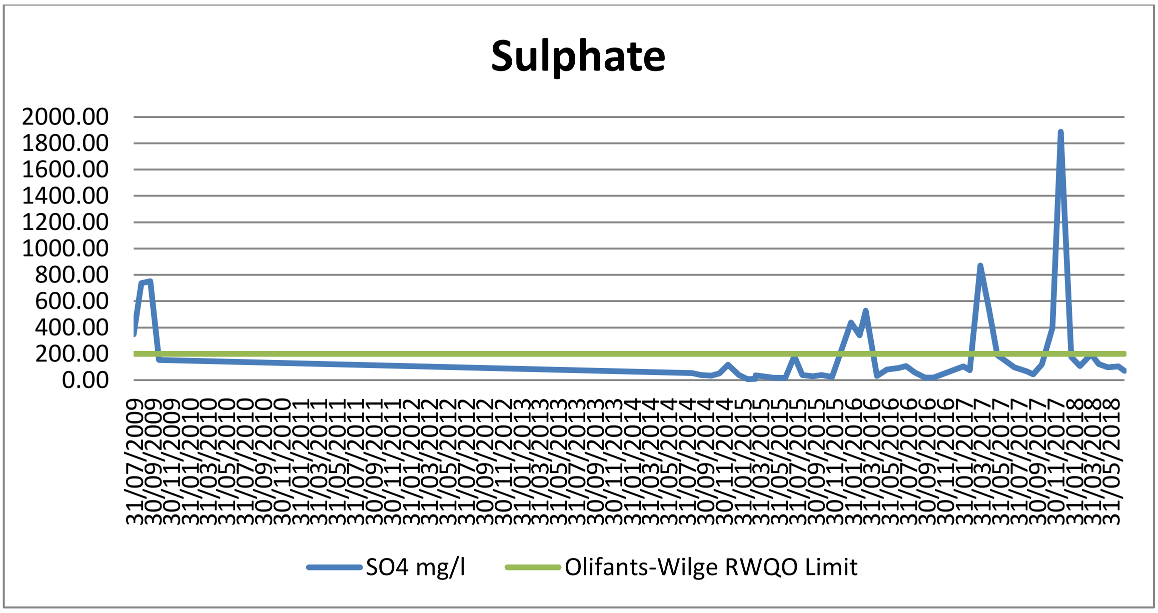

Figure 5-7: Sulphate trend at the downstream monitoring location (WelSW7/K17-Phola Bridge)

6 Water Balance

A mine wide water balance model was developed by Golder Associate in February 2017 and this was again updated in November 2018. The water balance informed the need for a Water Treatment Plant to treat the excess contaminated water from KPS mine.

However, KPS now intends to build an active Water Treatment Plant (WTP) capable of treating 10Ml/day of mine affected water from the Balancing Dam. The proposed WTP will be modular in design and constructed in three phases, starting at a capacity of 2Ml/day, upgradeable to 3.3Ml/day and then increments of 3.3Ml/day to 10Ml/day.

The excess contaminated water will be abstracted from the Balancing Dam at KPS and pumped to the WTP. After treatment, clean water that complies with the Resource Water Quality Objectives (RWQO) for the Olifants catchment is proposed to be discharged into the Saalklapspruit at the northern boundary of the KPS operation adjacent to the N12 national highway.

The design report indicated the water recovery rate of 95 -98 % whilst the brine is planned to be disposed off-site at an approved waste facility. The discharge rate and volumes rate was then calculated based on the 95% water recovery rate (0.02m^3/s) for 2Ml/day and water recovery rate of 0.11m^3/s for 10Ml/day treatment capacity. Figure 6-1 presents the WTP water balance whilst the mine site wide water balance is shown in Figure 6-2. The water balance figures on the Balancing Dam are based on the latest water balance by Golder Associates Africa (Pty) Ltd, (November 2018). A mine wide water balance model which will present the different treatment capacity scenarios is currently being updated and this will include all the water volumes inflows into the Balancing Dam. However, the main source of contaminated water contained in the balancing Dam is water from the pit workings.

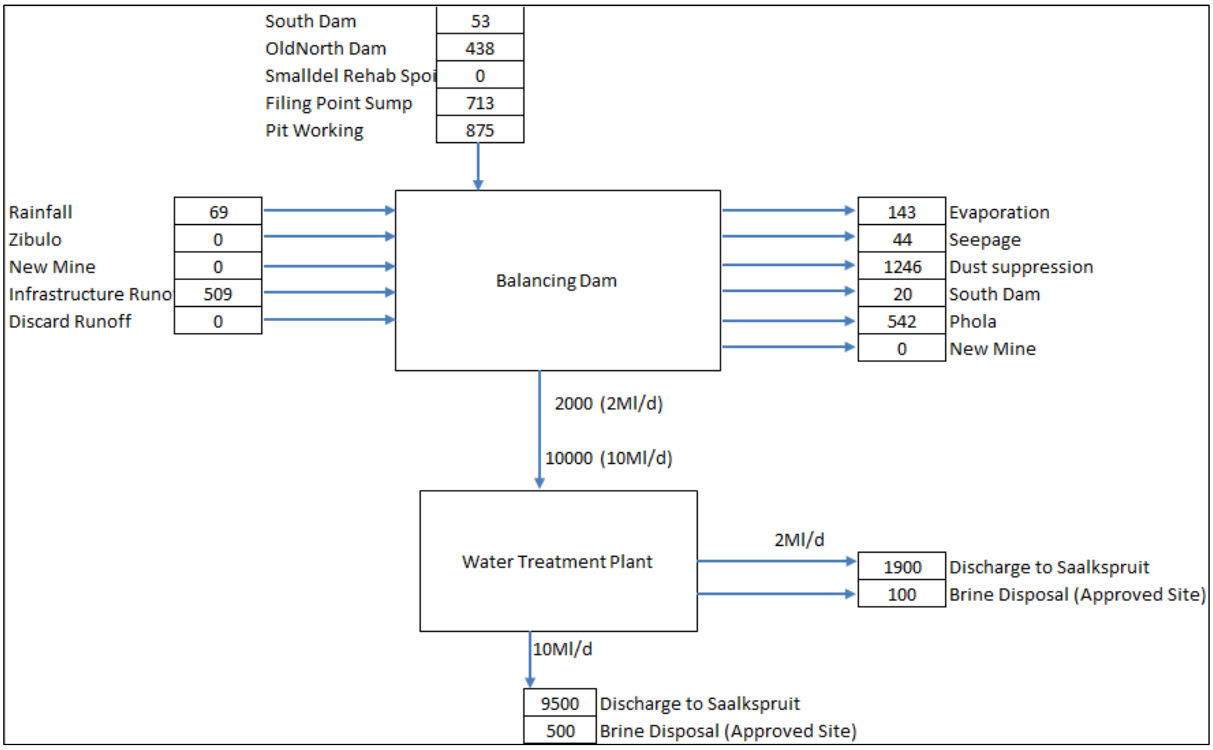

Figure 6-1: WTP Water Balance

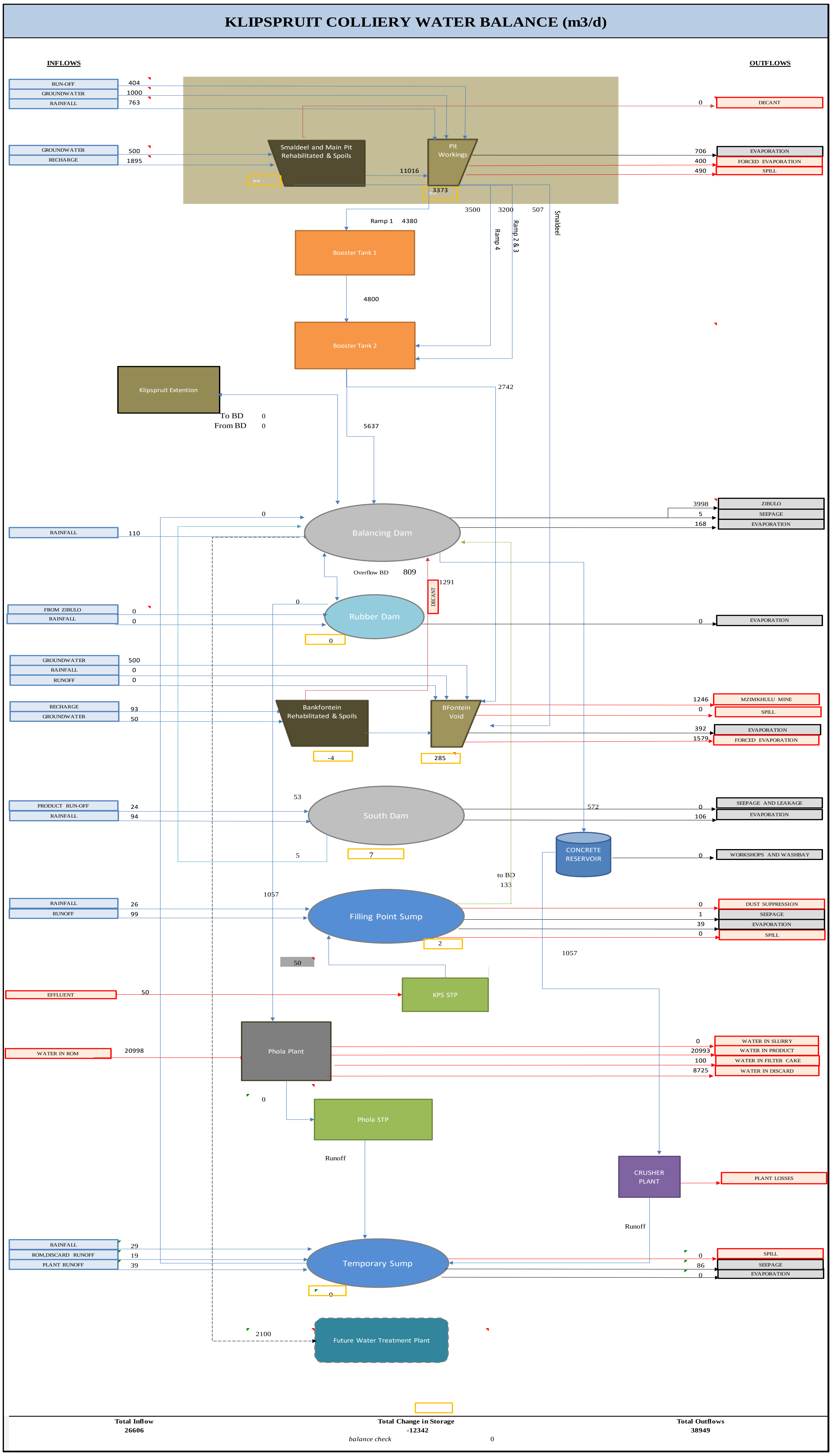

Figure 6-2: Existing Site Wide Water Balance (Golder Associates, 2018)

KPS water reticulation system was described as follows:

- The operation is based on three different opencast areas, viz. the Main Pit, Bankfontein (Mini Pit) and Smaldeel. At the time of development of the model mining at Bankfontein had topped.
- The major flow of water in the main pit is towards the north of the pit. Water collects in two different locations at the north of the Main pit, at Ramp 1 area (Ramp 1 sump) and "In-pit" water accumulation. Water is also collecting at the southernmost section of the Main Pit at the Ramp 4 area. Water collected at the sumps and pit of the main pit flows into the "dirty" water canal and is pumped to the Balancing Dam. The Mine requires two booster pumps to pump the water from the northern most sumps to the Balancing Dam. The Balancing Dam contains water from the Main Pit.
- Based on the surface contours for the opencast mining area, water flows from south to north of the Klipspruit site.
- Water from the Bankfontein and Smaldeel pits is now routed to the Balancing Dam and not the South Dam. Water from the Main Pit and Smaldeel can be routed to the Bankfontein sump. Runoff from the product stockpile is routed to the South Dam and the Balancing Dam. A pipeline is provided for pumping of water from/to the South Dam and the Balancing Dam.
- The filling point collection sump to the north of the Balancing Dam collects run-off from the administration building area. The Sewage Treatment Plant (STP) discharge is also pumped to the filling point collection sump. Water from the filling point collection sump is pumped to the Balancing Dam. Water from the filling point collection sump is also used for dust suppression of haul roads and the administration area.

7 Floodlines Delineations

The 1:100 year floodlines were delineated on the Saalklapspruit to determine the level of impact or the change in flood extent due to discharge of treated water from South32. The floodlines were modelled for two scenarios (pre-discharge and post discharge). The methodology and results are provided in the sections below.

7.1 Topography

Detailed contour elevation data was obtained from the client in dxf format and these contours were used to generate a 1m spatial resolution Digital Elevation Model (DEM). The DEM was used to obtain the longitudinal stream elevations and cross-sectional elevations. The catchment of the stream was delineated from the 5m contours obtained from the 1:50 000 topographical dataset for South Africa, as the contours provided by the client did not extend over the entire catchment area.

7.2 Land Cover and Soils

Land cover and soil data is necessary for the peak flow calculations. Land cover data was assessed during the site visit and the soil data was obtained from the soil assessment report (Digby Wells, 2017).

7.3 Manning's Roughness Coefficients

The Manning's roughness coefficients are values that describe the channel and adjacent floodplains resistance to flow. The Mannings roughness was assessed during the site visit and the following was noted:

The channel was shallow and not well defined but consisted of light small reeds and grass on the floodplains (Figure 7-1). According to the tables provided in Chow (1959), a Mannings n roughness coefficient of 0.03 was assigned to the channels. The adjacent floodplains consisted of grassland and a Mannings n roughness coefficient of 0.025 was assigned to these areas.

Figure 7-1: Channel consisting of some reeds and adjacent floodplains consisting of grassland

7.4 Peak Flow Calculation

The Rational Method is a hydrological method that was used to predict the peak flows. It is based on the following equation:

$$Q_T = \frac{C\ I\ A}{3.6}$$

where:

Q_T = Peak flow for a recurrence interval e.g. a 1:100-year flood (m^3/s)

C = Runoff coefficient (dimensionless)

I = Average rainfall intensity over the catchment (mm/hour)

A = Catchment area contributing to the peak flow (km^2)

3.6 = Conversion factor

7.5 Catchment Characteristics

Figure 7-2 indicates the delineated catchment for the floodlines determination, the rehabilitated area within the mine was also made part of the contributing catchment as the runoff from this area reports into the Saalklapspruit. The catchment characteristics, runoff coefficient, rainfall intensities and calculated peak flows are provided in Table 7-1.

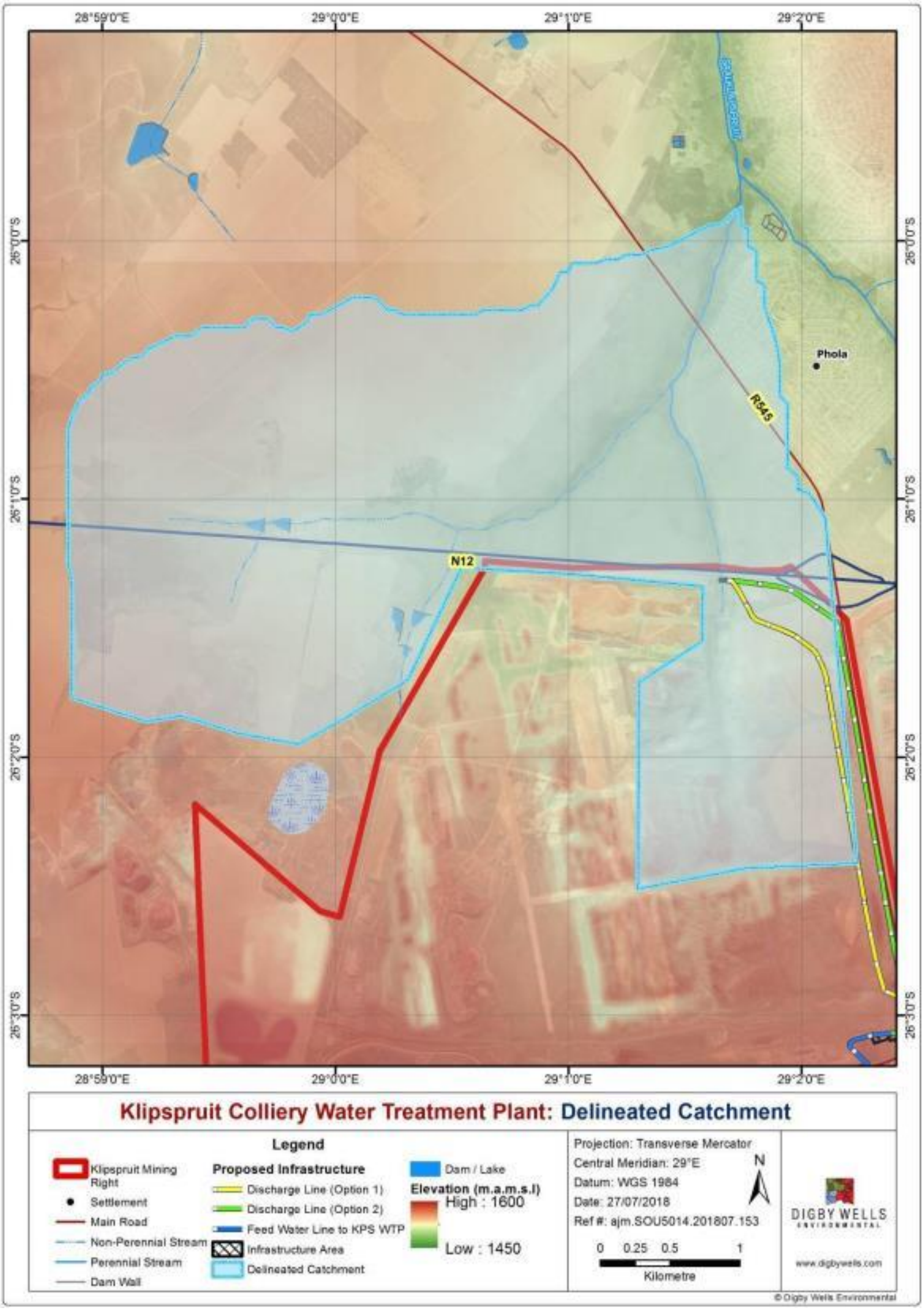

Figure 7-2: General topography and delineated catchment

Table 7-1: Catchment characteristics

MAP (mm)	686
Catchment Area (km²)	15.6
Longest Watercourse (km)	4.8
Height Difference along 10-85 (m)	14
Average Slope along 10-85 (m/m)	0.00389
1:100 Year Runoff Coefficient	0.407
Tc (hr)	1.88
1:100 Year Average Rainfall Intensity (mm/h)	66.3
Peak Flow Method	Rational
1:100 Year Peak Flow (m³/s)	116.85
Post Discharge 1:100 Year Peak Flow at 2Ml/D (m³/s)	116.87
Post Discharge 1:100 Year Peak Flow at 10Ml/D (m³/s)	116.96

8 Results and Recommendations

Figure 8-1 indicates the floodlines for Scenario 1, which is the current situation at the mine and Scenario 2, which includes the proposed discharge volume. The proposed water treatment will have a design treatment capacity of 2Ml/day at 95 - 98% water recovery, this will be upgraded up to a capacity of 10Ml/day. This water will then be discharged into the Saalklapspruit at calculated rate of 0.02m^3/s.

As can be seen, there is very little difference between the floodlines produced by the two scenarios. This is as a result of the proposed discharge volumes being very small. The amount of water to be discharged into the Saalklapspruit is very small and will not make a significant change on the flood peak. Therefore, discharge of treated water will not have an impact on the 1:100 year flood inundation along the Saalklapspruit.

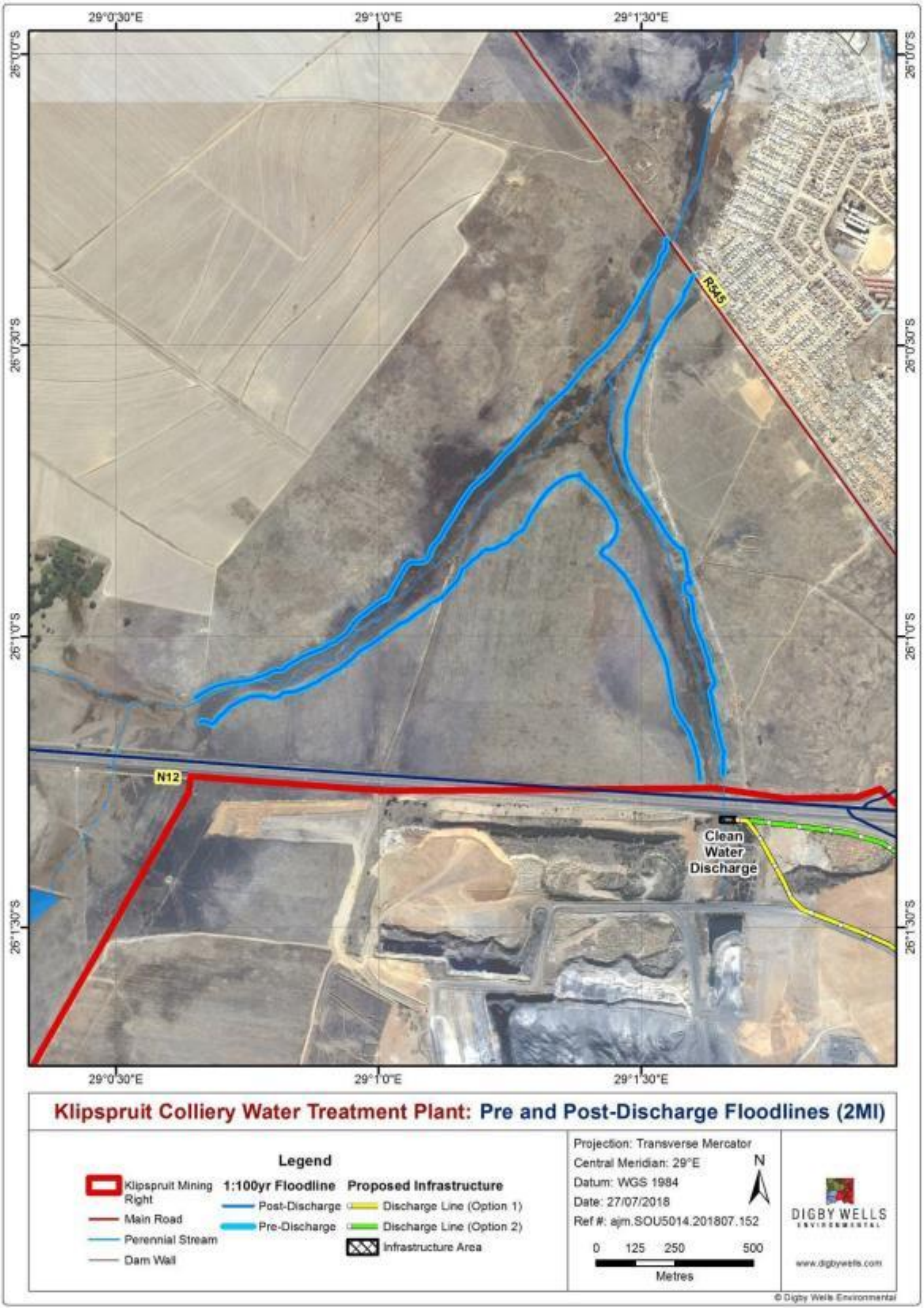

Figure 8-1: Floodlines for Scenario 1 and Scenario 2 at 2Ml/d

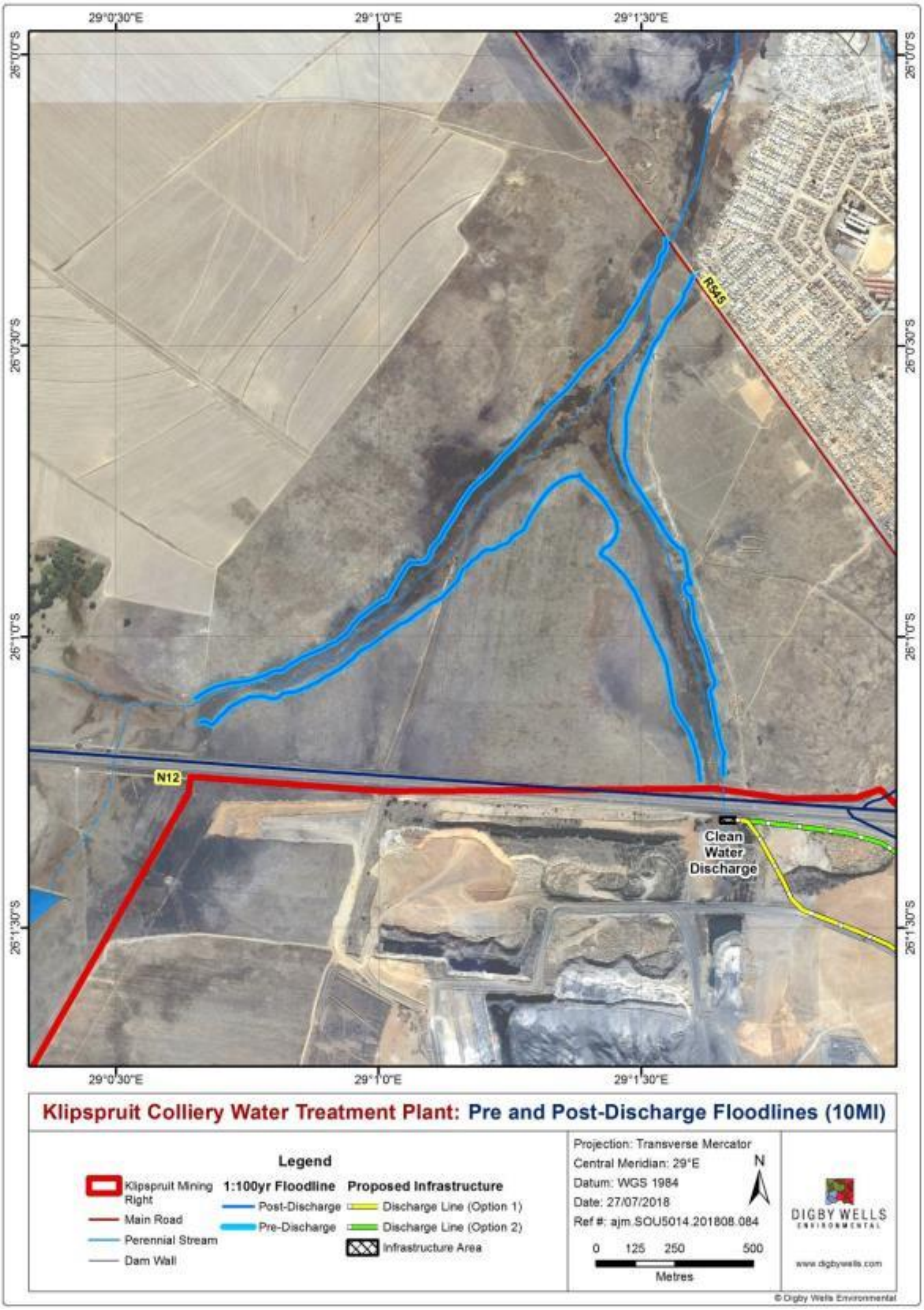

Figure 8-2: Floodlines for Scenario 1 and Scenario 2 at 10Ml/day

9 Environmental Impact Assessment

The environmental impact assessment has been completed in the manner described in the following sections.

9.1 Impact Rating Methodology

The methodology utilised to assess the significance of impacts is discussed in detail below. The significance rating formula is as follows:

Significance = Consequence x Probability

Where

Consequence = Type of Impact x (Intensity + Spatial Scale + Duration)

And

Probability = Likelihood of an Impact Occurring

In addition, the formula for calculating consequence:

***Type of Impact** = **+1** (Positive Impact) or **-1** (Negative Impact)*

The weight assigned to the various parameters for positive and negative impacts is provided for in the formula and is presented in Table 9-1. The probability consequence matrix for impacts is displayed in Table 9-2, with the impact significance rating described in Table 9-3.

Table 9-1: Surface Water Impact Assessment Parameter Ratings

Rating	Intensity		Spatial scale	Duration	Probability
	Negative Impacts ***(Type of Impact = -1)***	***Positive Impacts*** ***(Type of Impact = +1)***			
7	High significant impact on the environment. Irreparable damage to highly valued species, habitat or ecosystem. Persistent severe damage. Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	Noticeable, on-going social and environmental benefits which have improved the livelihoods and living standards of the local community in general and the environmental features.	International The effect will occur across international borders.	Permanent: No Mitigation The impact will remain long after the life of the Project.	Certain/ Definite. There are sound scientific reasons to expect that the impact will definitely occur.
6	Significant impact on highly valued species, habitat or ecosystem. Irreparable damage to highly valued items of cultural significance or breakdown of social order.	Great improvement to livelihoods and living standards of a large percentage of population, as well as significant increase in the quality of the receiving environment.	National Will affect the entire country.	Beyond Project Life The impact will remain for some time after the life of a Project.	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	On-going and widespread positive benefits to local communities which	Province/ Region Will affect the entire province	Project Life The impact will cease after the operational life span of the	Likely The impact may occur.

Rating	Intensity		Spatial scale	Duration	Probability
	Negative Impacts ***(Type of Impact = -1)***	***Positive Impacts*** ***(Type of Impact = +1)***			
	rehabilitate. Very serious widespread social impacts. Irreparable damage to highly valued items.	improves livelihoods, as well as a positive improvement to the receiving environment.	or region.	Project.	
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense social benefits to some people. Average to intense environmental enhancements.	Municipal Area Will affect the whole municipal area.	Long term 6-15 years.	Probable Has occurred here or elsewhere and could 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.	Average, on-going positive benefits, not widespread but felt by some.	Local Extending across the site and to nearby settlements.	Medium term 1-5 years.	Unlikely Has not happened yet but could happen once in the lifetime of the Project, therefore there is a possibility that the impact will occur.

Rating	Intensity		Spatial scale	Duration	Probability
	Negative Impacts ***(Type of Impact = -1)***	***Positive Impacts*** ***(Type of Impact = +1)***			
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.	Low positive impacts experience by very few of population.	Limited Limited to the site and its immediate surroundings.	Short term Less than 1 year.	Rare/ improbable 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 that will have no impact on the environment. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level social and environmental benefits felt by very few of the population.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month.	Highly unlikely/None Expected never to happen.

Table 9-2: Probability Consequence Matrix for Impacts

Probability	Significance																																					
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	**-20**	**-19**	**-18**	**-17**	**-16**	**-15**	**-14**	**-13**	**-12**	**-11**	**-10**	**-9**	**-8**	**-7**	**-6**	**-5**	**-4**	**-3**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Consequence																																						

Table 9-3: Significance Threshold Limits

Score	Description	Rating
109 to 147	A very beneficial impact which may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	**Major (positive)**
73 to 108	A beneficial impact which may help to justify the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment.	Moderate (positive)
36 to 72	An important positive impact. The impact is insufficient by itself to justify the implementation of the Project. These impacts will usually result in positive medium to long-term effect on the social and/or natural environment.	Minor (positive)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the social and/or natural environment.	Negligible (positive)
-3 to -35	An acceptable negative impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the social and/or natural environment.	Negligible (negative)
-36 to -72	An important negative impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the Project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the social and/or natural environment.	Minor (negative)
-73 to -108	A serious negative impact which may prevent the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe effects.	Moderate (negative)
-109 to -147	A very serious negative impact which may be sufficient by itself to prevent implementation of the Project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects.	Major (negative)

9.2 Identified Potential Impacts

Although water is an essential requirement in the mine for various purposes (coal washing, dust suppression, potable water for workers on site, etc.), the use of water in mining has the potential to affect the quality of surrounding surface water, groundwater and other aspect of the environment. It is a requirement for the mines to contain and re-use their dirty water within the mine operational processes, to avoid discharge and contamination of the natural water resources.

However, if the dirty water contained within the mine exceeds the demand within the mine, water could either be transferred to another user or be treated before discharging it to the natural water resources. The proposed WTP footprint and associated pipelines are located within the KPS Mining Right area. This WTP will have negligible negative impacts onto the natural water resources as it serves as a remedial measure to prevent a potential negative impact when dirty water runoff from the mine reports into nearby streams.

However, activities during construction and operation may have some impacts on the natural surface water system, i.e. hydrological impact, water quality and water quantity. These potential impacts, their descriptions and the significance rating are provided below.

9.2.1 Construction Phase

Activities during the construction phase that may have potential impacts (Table 9-4) on the surface water resources are described and the appropriate management/mitigation measures are provided below.

Table 9-4: Interactions and Impacts of Activity

Interaction	Impact
Exposure of soils due to loss of vegetation (site clearance).	Siltation of the Saalklapspruit leading to deteriorated water quality.
Fuel or chemical spills during construction activities.	Surface water contamination leading to deterioration in water quality of Saalklapspruit

9.2.1.1 Impact Description: Siltation of the Saalklapspruit Leading to Deteriorated Water Quality

Construction of infrastructure will require site clearance or removal of vegetation. This may result in an increased potential for soil erosion on site which leads to increase in the sediments on the runoff that reports into the natural stream thereby causing siltation.

Also, dust generated during the construction activities and caused by increased vehicular movements and construction of discharge dissipation structures can also be deposited into the water course, thereby contributing to the accumulation of suspended solids in the water course, leading to the siltation of the water.

As mentioned above, the proposed WTP and its associated discharge line and dissipation infrastructure is located within an existing KPS mine boundary where there are storm water management structures and dust suppression measures in place. This impact would most likely be of low significance.

9.2.1.2 Impact Description: Water Contamination

Water contamination may occur as a result of runoff emanating from the contaminated surfaces within the mine reporting into the surrounding streams; this is if there are no measures in place to contain the dirty water. These impacts will lead to the deterioration of water quality and impacting the aquatic life and the downstream water users as well.

9.2.1.3 Management/ Mitigation Measures

The following mitigation measures are recommended:

- The WTP proposed area has already been disturbed. However, where clearing of vegetation and excavation will be required (along the discharge line and dissipation infrastructure location), this should only be limited to their proposed development footprint;
- For any required soil stockpiles, these should be compacted and the slopes should be kept at minimal/low to avoid erosion by high runoff velocity from the stockpile and hence siltation of the streams;
- Dust suppression measures must be undertaken on the cleared areas during construction;
- Runoff from this area should be directed to the existing storm water management infrastructures and should not be allowed to flow into the stream; and
- All storage areas (fuels, paints, chemicals etc) should be appropriately bunded and spill kits should be in place, and construction workers trained in the use of spill kits, to contain and immediately clean up any potential leakages or spills.

Table 9-5: Impact significance rating for the construction phase

Impact: Siltation of surface water resources leading to deteriorated water quality			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	2	The impact will likely occur during the construction phase only	32-Negligible (negative)
Intensity	2	This will have minor medium-term impacts resulting in a reduction in water quality for immediate downstream users and the aquatic life	
Spatial scale	4	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	

Probability	4	Without appropriate mitigation, it is probable that this impact will occur	
Post-mitigation			
Duration	2	The impact will likely only occur during the construction phase	8-Negligible (negative)
Intensity	2	Should the impact occur, it will have minor medium-term impacts resulting in a reduction in water quality for downstream users and the aquatic life	
Spatial scale	4	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	2	With the existing measures already in place. It will be rare/improbable for this impact to occur.	

Impact: Water Contamination			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	2	The impact will likely only occur during the construction phase	48- Minor (negative)
Intensity	3	This will moderately impact the water quality and the ecosystem functionality for downstream users	
Spatial scale	3	The impacts may extend in the greater surrounding area from where the impact occurred	
Probability	4	Without appropriate mitigation, it is probable that this impact will occur	
Post-mitigation			
Duration	2	The impact will likely only occur during the construction phase	24-Negligible (negative)
Intensity	3	This will moderately impact the water quality and the ecosystem functionality for downstream users	
Spatial scale	3	The impacts may extend in the greater surrounding area from where the impact occurred	
Probability	2	With the existing measures already in place. It will be rare/improbable for this impact to occur.	

9.2.2 Operational Phase

Activities during the operational phase that may have potential impacts (Table 9-6) on the surface water resources are described and the appropriate management/mitigation measures are provided below.

The final phase of the WTP will ensure a Zero Liquid discharge, of which the sludge/solid waste/brine will be disposed of at an approved hazardous waste disposal site, therefore disposal of the waste product was not included on the impact assessment.

Table 9-6: Interactions and Impacts of Activity

Interaction	Impact
Discharge of treated water during operation of the WTP	Alteration of natural hydrology and stream erosion due to increased volumes and water velocity.
	In-stream water quality improvement
	Restoration of runoff catchment yield.

9.2.2.1 Impact Description: Alteration of natural hydrology and stream erosion due to increased volumes and water velocity

The proposed WTP will be discharging water at the Saalklapspruit, this may cause an increase on the volumes and flow rate of the stream. This has the potential to impact on the stream by altering natural hydrology, generally leading to more frequent, larger magnitude, and shorter duration peak flows. It alters the natural stream channel morphology, generally leading to changes such as increased channel width, increased down cutting/vertical erosion, and reduced bank stability.

9.2.2.1 Impact Description: Instream water quality improvement

The current water quality status for along the Saalklapspruit is impacted as concentration levels of various parameters are above the RWQO set by DWS for the Wilge River Catchment Region for the Upper and Middle Olifants. As such, this water is considered to be of poor quality and contaminated.

The proposed WTP will be treating contaminated mine water from the Balancing Dam to comply with the Wilge RWQO and this is proposed to be discharged or released into the Saalklapspruit. A positive impact will be realised as this water will dilute the already impacted water and hence improves the in-stream water quality. Continuous water quality monitoring will be conducted to assess and quantify the improvement (based on the historical water quality records) is recommended.

9.2.2.1 Impact Description: Restoration of runoff catchment yield

In accordance with the Government Notice 704 (GN 704) of the NWA, the mine is required to separate clean and dirty water to prevent contamination of the clean water resources. Dirty water is required to be contained for re-use in the mine processes.

In pre-mining period, this is the runoff which could have been reporting into the natural streams, so containment of dirty water runoff in the mine reduces the amount of runoff reporting to the Saalklapspruit and the catchment as a whole. A decrease in the catchment yield may have an impact on the downstream water users as they may not have sufficient water for their needs, while also decreasing the required natural ecological flows.

A positive impact will also be realised in this regard, water being released onto the Saalklapspruit will compensate and restore the flows prior to mining conditions.

9.2.2.2 Management/ Mitigation Measures

Alteration of natural hydrology can be prevented by installing energy dissipaters at the discharge point to avoid erosion of the riverbed and banks. These could be in a form of gabions, silt trap, chutes spillway, etc. to ensure reduction of water velocity (see image below). The design report by Prentec (1 June 2018) has specified that water will be discharged to the catchment area via a dissipating structure to minimise erosion.

Water quality monitoring should continue at the outlet and downstream points of the Saalklapspruit to ensure the WTP effectiveness so the positive impacts can be realised.

Table 9-7: Impact significance rating for the operational phase

Impact: Alteration of natural hydrology due to increased runoff.			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will occur for as long as the project life of WTP	78 Moderate (negative)
Intensity	4	This may have serious to medium term the natural impacts to the hydrology and the general river well -being	
Spatial scale	4	The impacts may extend in the greater surrounding area (Municipal) from where the impact occurred	
Probability	6	Without appropriate mitigation, it is almost certain that the impact will occur	
Post-mitigation			
Duration	5	The impact will occur for as long as the project life of WTP and could be mitigated by recommendation made above	39 Minor (negative)
Intensity	4	This may have serious to medium term the natural impacts to the hydrology and the general river well -being	
Spatial scale	4	The impacts may extend in the greater surrounding area (Municipal) from where the impact occurred	
Probability	3	It is unlikely for this impact to happen if there are mitigation measures in place	

Impact: Instream water quality improvement			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will occur for as long as the project life of WTP	119 Major (positive)
Intensity	7	This will have very significant impacts to the water quality and the general river well - being	
Spatial scale	5	The impacts may extend in the provincial from where the impact occurred	
Probability	7	It is certain/ definite that this impact will occur (there is no mitigation for this impact)	
Impact: Restoration of runoff catchment yield			
Duration	5	The impact will occur for as long as the project life of WTP	119 Major (positive)
Intensity	7	This will have very significant impacts to the	

		water quality and the general river well - being	
Spatial scale	5	The impacts may extend in the provincial from where the impact occurred	
Probability	7	It is certain/ definite that this impact will occur (there is no mitigation for this impact)	

9.2.3 Closure and Rehabilitation Phase

Activities during this phase include dismantling and removal of infrastructure and surface rehabilitation. The major impacts to consider in the decommissioning and rehabilitation of the site will be siltation of surface water resources as a result of soil erosion influenced by removal of infrastructures. Potential impacts (Table 9-8) on the surface water resources are described and the appropriate management/mitigation measures are provided below.

Table 9-8: Interactions and Impacts of Activity

Interaction	Impact
Exposure of soils due to loss of vegetation (site clearance).	Siltation of the Saalklapspruit leading to deteriorated water quality.

9.2.3.1 Impact Description: Siltation of the Saalklapspruit Leading to Deteriorated Water Quality

Removal of infrastructure will expose the soil surfaces and leave it prone to erosion which leads to increase in the sediments on the runoff that reports into the natural stream thereby causing siltation (Saalklapspruit).

9.2.3.2 Impact Description: Water Contamination

Water contamination may occur as a result of runoff emanating from the contaminated surfaces within the mine reporting into the surrounding streams; this is if there are no measures in place to contain the dirty water. These impacts will lead to the deterioration of water quality and impacting the aquatic life and the downstream water users as well.

9.2.3.3 Management/ Mitigation Measures

The following mitigation measures are recommended:

- Use of accredited contractors for removal or demolition of infrastructures must be ensured, this will reduce the risk of waste generation and accidental spillages;
- Rehabilitated and backfilled area must be seeded, where seeding is not effective, sedimentation should be mitigated by installing silt traps at areas where the surface runoff enters the surface water resources;
- The constructed dirty water trenches and berms will have to remain until post closure. This will ensure dirty water is captured and contained during removal of infrastructures;

- Surface inspection on the fully rehabilitated areas must be undertaken to ensure a surface profile that allows good drainage. This will ensure improvement or increased catchment yield on to the surrounding streams; and
- Water quality monitoring should continue to determine if there are any residual impacts and enable implantation of mitigation measures.

Table 9-9: Impact significance rating for the closure and rehabilitation phase

Impact: Siltation of surface water resources leading to deteriorated water quality			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	2	The impact will likely occur during the closure phase only	32-Negligible (negative)
Intensity	2	This will have minor medium-term impacts resulting in a reduction in water quality for immediate downstream users and the aquatic life	
Spatial scale	4	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	4	Without appropriate mitigation, it is probable that this impact will occur	
Post-mitigation			
Duration	2	The impact will likely only occur during the closure phase	8-Negligible (negative)
Intensity	2	Should the impact occur, it will have minor medium-term impacts resulting in a reduction in water quality for downstream users and the aquatic life	
Spatial scale	4	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	2	With the existing measures already in place. It will be rare/improbable for this impact to occur.	

9.3 Unplanned Events and Low Risks

The potential risks or unplanned events involve accidental spillages of hazardous substances (e.g. hydrocarbons) from vehicles or other machineries and from waste storage facilities during construction, operation and closure phases. This may lead to impacts on water quality in the surrounding streams, should runoff from these contaminated areas enter the system.

There is also a risk of flooding of the Saalklapspruit due to increased or additional volumes from the discharge. Flooding may cause subsequent damage to properties and infrastructure that are placed within the flood extent.

Also, flooding may lead to mobilisation of hazardous substances from the mainland and this may impact on the river water quality. A summary of the risks or unplanned events, together with the management measures are presented in Table 9-10.

However, in consideration of the proposed discharges (2Ml/day and 10Ml/day), the impact on the 24 hour peak flows of the Saalklapspruit is small and will not make a significant change on the 1:100 year flood extent or inundations along the Saalklapspruit.

Table 9-10: Unplanned Events, Low Risks and their Management Measures

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbons and any hazardous material spillage	Surface water contamination	Vehicles must only be serviced within designated service bays. The management of general and other forms of waste must ensure collection and disposal into clearly marked skip bins that can be collected by approved contractors for disposal to the appropriate disposal sites. The fuel, lubricant and explosives storage facilities must be located on a hard standing area (paved or concrete surface that is impermeable), roofed and bunded in accordance with SANS1200 specifications. This will prevent mobilisation of leaked hazardous substances. An emergency spillage response plan and spill kits should be in place and accessible to the responsible monitoring team. The Material Safety Data Sheets (MSDS) should be kept on site for the Life of Mine for reference to anytime in terms of handling, storage and disposal of materials.
Flooding of Saalklapspruit	Surface water contamination and subsequent damage to property	The amount of water to be discharged into the Saalklapspruit is very small and will not make a significant change on the 1:100 year flood peak. Monitoring of discharge volume is also recommended to ensure a controlled discharge
Pipeline Bursts	Siltation of water due to uncontrolled flow resulting in erosion	Maintenance and inspections on the pipeline must be done on to minimise chances of bursts.

10 Surface Water Monitoring Plan

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.

South32 has an existing monitoring programme in place. It is recommended that this monitoring should continue throughout the life of mine and the proposed WTP. All water quality results should be benchmarked with the Resource Quality Objectives of Water

Resources for the Olifants Catchment to determine any impact on the quality of water (positive/negative). The surface water monitoring plan is summarised as follows:

Table 10-1: Surface Water Monitoring Plan

Monitoring Element	Comment	Frequency	Responsibility
Water quality	Ensure water quality monitoring as per existing monitoring programme and all the locations indicated in Table 5-1. Parameters should include but not limited to; Aluminium, hydrocarbons, Sulphates, Phosphates, Iron, Manganese, Calcium, Magnesium, Nitrate, Ammonia, Fluoride, Chloride, pH, Electrical Conductivity, Total dissolved solids, Suspended Solids; Sodium, Potassium, Arsenic, Chromium VI, Copper, Mercury, Lead, Selenium, and Zinc.	-Monthly during construction and operation (hydrocabons can be done on a quarterly basis). -Monitoring needs to carry on three years after the project has ceased, as is standard practice to detect residual impacts.	Environmental Officer
Water quantity	Flow monitoring should be carried out downstream of discharge point to ensure a controlled discharge and effectiveness of discharge point energy dissipaters. The discharge pipeline should be equipped with instantaneous or automatic flow meters to ensure real time measurements of discharge water.	In operational areas where automatic flow meters are in place, daily records need to be kept	Environmental Officer
Physical structures and Storm Water Management Plan (SWMP) performance	Personnel should have a walk around facilities to determine the facilities conditions and pick out any anomalies such as leaks or overflows and system malfunctions. Storm water channels, and existing mine dams are inspected for silting and blockages of inflows, pipelines for hydraulic integrity; monitor the overall SWMP performance.	Continuous process and yearly formal report	Environmental Officer
Meteorological data	Measure rainfall	Real time system if in place	Sampler

11 Conclusion and Recommendations

The current water quality status along the Saalklapspruit is impacted as concentration levels of various parameters are above the RWQO set by DWS for the Wilge River Catchment Region for the Upper and Middle Olifants. As such, this water is considered to be of poor quality and contaminated. This stream has been classified as class D, based on its Present Ecological Status (PES) which basically implies that it has been largely modified.

The proposed WTP will be treating contaminated mine water from the balancing dam to comply with the Wilge RWQO and this is proposed to be discharged or released into the Saalklapspruit. A positive impact will be realised as this water will dilute the already impacted water and hence improves the in-stream water quality. Continuous water quality monitoring to assess and quantify the improvement (based on the historical water quality records) is recommended.

The proposed WTP footprint and associated pipelines are located within the already disturbed South32 KPS mine boundary. This WTP, its associated infrastructures and discharge activities does not pose a significant threat to impact the natural water resources as it serves as a remedial measure to prevent potential impact when dirty water runoff from the mine reports into nearby streams.

In consideration of the proposed discharges (2Ml/day and 10Ml/day), the impact on the 24 hour peak flows of the Saalklapspruit is small and will not make a significant change on the 1:100 year flood extent or inundations along the Saalklapspruit.

However, certain activities during construction and operation of the WTP may have some potential impacts on the natural surface water system if not mitigated as per the recommendations in this report, i.e. hydrological impact, water quality and water quantity.

Appropriate mitigation/management measures to prevent, and/or minimise all the identified potential surface water impacts are detailed in this report. Furthermore, the positive impact of this project greatly outweighs the potential negative impacts as these were rated to be of low significance. Therefore with all the mitigation and management measures in place, this project will not pose any threat into the natural surface water resources and can therefore go ahead.

12 References

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Appendix A: Appendix Title

Appendix B: Appendix Title