De Beers Consolidated Mine (Pty) Ltd: Venetia Mine

Surface Water Assessment in support of the proposed Storm Water Management Project

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SHANGONI
Management Services (Pty) Ltd

Stewards Problem Solvers Team Players

Influencing decisions since 2000 through identification, quantification and mitigation of environmental, safety, health and compliance risks

Executive Summary

Shangoni Management Services (Pty) Ltd ("Shangoni") was appointed by De Beers Consolidated Mines (Pty) Ltd: Venetia Mine ("Venetia Mine") to compile a Surface Water Assessment ("SWA") in support of the proposed Venetia Mine Storm Water Management Project ("the Project"). Venetia Mine is an existing opencast diamond located in the Limpopo Province and is currently undertaking a sizeable venture to convert the mine from an open pit operation to an underground mine, referred to as the Venetia Underground Project ("VUP"). Open pit mining is expected to continue until the end of 2021 and production in the underground mine is scheduled to commence in 2022 and will continue to 2043. Accordingly, Venetia Mine has identified the need to construct additional storm water management infrastructure and containment facilities and to expand some of the existing facilities (i.e., the Project). The overall aim of the Project is to ensure full legal compliance with the National Water Act (Act No. 36 of 1998) and Regulation GN 704, specifically regarding the containment of contaminated water on site and the separation of clean and dirty water. In addition, the Project will enable Venetia Mine to better implement principles of water conservation, improve water security, and reduce the mine's freshwater intake from the wellfields.

The main objective of this SWA is to assess the potential impact of the Project on the quantity and quality of surface water resources in the area. In summary, the following main conclusions were made in terms of the potential impacts on surface water resulting from the Project.

- Currently the main risk associated with surface water at Venetia Mine is the potential deterioration of surface water quality in the receiving environment resulting from affected water leaving the mine site. The Project will reduce this risk as all affected water generated on site will be contained and dirty runoff will be separated from clean runoff more effectively, resulting in an overall positive impact on surface water quality. The Project will also limit the likelihood of Pollution Control Dam ("PCD") spillages to less than 2% (i.e., less 1 in 50 years on average) as per the requirements of Regulation GN 704.
- The main negative impact on surface water quality resulting from the Project is associated with the construction / expansion of the proposed facilities. There may be a reduction in surface water quality when any surface water comes into contact with dust, eroded soil, or other pollutants generated at the construction sites. This impact will, however, only be temporary and can be mitigated.
- Another potential negative impact on surface water quality associated with the Project is the proposed discharge of affected mine water into the receiving environment. The discharge of affected water will only be conducted should there be insufficient capacity and in accordance with the relevant environmental authorisations. The significance of this impact on surface water quality will be determined as part of the aquatic biodiversity assessment.
- In terms of surface water quantity, there will only be a continuation of the existing impact. The area applicable to the Project is already considered a dirty water area with affected runoff being contained in the SWCD and runoff / rainfall already enters the open pits, reducing the amount of water reporting to the larger catchment area. The only change to this impact will be that more affected runoff will be

collected and contained in PCD 3 and there will be additional facilities constructed that will collect direct rainfall directly. That being said, the Project will also enable Venetia Mine to reduce their reliance on freshwater intakes from the wellfields, which will have a positive impact on the surface water quantity of the larger catchment.

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Terminology

Aquatic ecosystem: Refers to those physical and biological features, including land, water, the atmosphere, flora and fauna, which are within, under, over in contact with, or sustained by the water in water bodies.

Berm: (1) A wall usually constructed using raw material (e.g. gravel, soil or rock) with the purpose to divert the natural flow path of surface water. (2) A ledge formed at the bottom of an earth slope or at some level intermediate between the bottom and the top.

Catchment: The area from which any rainfall will drain through surface flow to a common point or points.

Clean water: Water that complies with a negotiated standard or natural runoff that has not been contaminated with known pollutants.

Concentration time: The period of time required for storm runoff to flow from the most remote point of a catchment or drainage area to the outlet of point under consideration.

Design storm: A particular combination of rainfall conditions generally expressed as a total quantity of precipitation, expressed as mm of rainfall, or a short-term intensity, expressed as mm per hour, in combination with a defined recurrence interval.

Design flood: (1) The largest flow that a reservoir, channel, or other works can accommodate without damage or with limited damage. (2) The flood adopted for use in determining the hydraulic proportions of a structure such as the outlet works of a dam, the height of a dam of levee, or the maximum water level in a reservoir. Also called plan flood.

Dirty water: Water that has been exposed, or could potentially be exposed, to known pollutants.

Drainage area: The total land area that drains to a specified point comprises the drainage area for that point. The area of a drainage basin or watershed is expressed in hectares, square kilometres, acres, square miles or any other unit of interest.

Drainage density: The relative density of natural drainage channels in a given area. It is usually expressed in terms of km or miles of natural drainage of stream channel per square km. or mile of area, and obtained by dividing the total length of stream channels in the area in km or miles by the area in square km or miles.

Dirty water system: Any system designed to collect, convey or contain dirty water.

Drainage trench: An artificial flow path designed to convey water.

Diversion: A channel with a supporting ridge on the lower side constructed across the slope to divert water from areas where it is in excess to sites where it can be used or disposed of safely. Diversion differ from terraces in that they are individually designed.

Effluent: Includes any flowing-out or fluid material discharged from domestic or industrial wastes systems which, by reason of its quality, quantity or characteristics, is likely to impair the beneficial use of receiving water by adversely affecting its natural state.

Effluent standards: The standard for treatment and discharge of effluent promulgated under the Environmental Management Act (2004) of Tanzania.

Erosion: (1) The wearing away of land surface by running water, wind, ice or other geological agents, including such processes as gravitational creep. (2) Detachment and movement of soil or rock fragments by water, wind, ice or gravity.

Flood peak: Maximum rate of flow, usually expressed in cubic metres per second, that occurred during a flood.

Flood plain: Land that adjoins the channel of a natural steam and that is subject to overflow flooding. In hydrologic terms it is an area subject to inundation of floods of a particular frequency (10- year, 20-year floodplain etc.).

Geographic Information System: An information system that combines tabular information with graphic data for efficient collection, storage, retrieval, analysis, and display of spatial data.

Hydrograph: A graph showing, for a given point on a stream or conduit, the discharge, stage, velocity, available power, or other property with respect to time.

Incident: Includes any incident or accident in which a substance pollutes or has the potential to pollute or have a detrimental effect on a water resource.

Infiltration rate: (1) The rate at which water enters the soil of other porous material under a given condition. (2) The rate which infiltration takes place, expressed in depth of water per unit time, usually in mm or inches per hour. (3) The rate, usually expressed in cubic feet per second or cubic metres per second at which groundwater enters an infiltration ditch or gully, drain sewer, or other underground conduit.

Interflow: The movement of water of a given density in a reservoir or lake between layers of water of different density. It is usually caused by the inflow of water either of a different temperature or of a different sediment or salt content.

Life of mine: The life of mine includes all the phases of the mine's existence from the conceptual and planning phases, through design, construction, operation and decommissioning to the post-closure and aftercare phases.

Peak flow runoff: Runoff from an area following a hydrograph curve during a storm event. A maximum runoff rate is experienced during the storm event and this rate is referred to as the peak flow runoff.

Pollution: In relation to water resources, means any direct or indirect alteration of the physical, thermal, chemical or biological properties of the water resource so as to make it:

a) less fit for any beneficial purpose for which it is or may reasonably be expected to be used; or
b) harmful or potentially harmful to –

- i. the welfare, health or safety of human beings;
- ii. any aquatic or non-aquatic life or property; or the environment.

Pump station; pumping station: (1) A structure containing pumps and appurtenant piping, valves and other mechanical and electrical equipment for pumping water, wastewater, or other liquids. (2) Pump house is the usual term for shelters for small water pumps. Can be called lift station.

Seepage: (1) Water escaping through or emerging from the ground. (2) The process by which water percolates through the soil. (3) Percolation of water through the lithosphere. Definitive meaning is usually described by an adjective such as influent, effluent. (4) The slow movement of water through small cracks, pores or interstices of a material into or out of a body of surface or subsurface water. (5) The loss of water by infiltration from a canal, reservoir or other body of water, or from a field. It is generally expressed as flow volume per unit time. During the process of priming, such loss is called absorption loss.

Sediment trap: (1) A temporary structure or a vegetative barrier designed to trap sediment in runoff before it enters storm water pipes, channels or steam. It is usually designed to control runoff from only small catchments. (2) A device, often a simple enlargement in cross sectional area, placed in a conduit to arrest, by deposition, the sand or silt carried by the water. It usually includes means for ejecting the settled material. Also called a sand trap.

Soil group, hydrologic: A classification of soils by the U.S. Soil Conservation Service into four runoff potential groups. The groups range from A soils, which are very permeable and produce little runoff, to D soils, which are not very permeable and produce much more runoff.

Soil infiltration rate: The maximum rate at which a soil, in a given condition at a given time, can absorb water.

Stream: Refers to the water contained in a watercourse and includes a river.

Surface water: All water flowing over the surface of the ground, or contained in a spring or natural lake or reservoir or swamp and all water contained directly underneath a river bed.

Surface runoff: Water falling as rainfall and is not lost through evaporation, transpiration or infiltration thereby flowing above the ground surface after deposition.

Sustainable management: Means managing the use, development and protection of water resources in a manner, or at a rate, which provides for the social, economic, sanitation and cultural well-being of the people, while safeguarding the life-supporting capacity of water for the ecosystem both in the present and the future.

Watercourse: Defined as a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake or dam into which, or from which, water flows; and any collection of water that the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Water source: Refers to the following:

a) a river, tributary, estuary, lake, swamp, marsh or other wetland;
b) an aquifer or a spring;
c) sea waters and interface between sea water and fresh water; and
d) a dam, pond or reservoir.

Works: Include canals, channels, reservoirs, embankments, weirs, dams, wells, boreholes and other works constructed for or in connection with the diversion, damming, storage or abstraction of water, or for the protection of rivers, lakes, or any other water sources, or for the conservation of water, or for drainage or for the use of water for any purposes of for the conservation of rainfall.

Assumptions and limitations

- Whilst every endeavour has been made by Shangoni to ensure that information provided is correct and relevant, this technical report is, of necessity, based on information that could reasonably have been sourced within the time period allocated to the assessment, and is, furthermore, of necessity, dependent on information provided by management and/or its representatives during the course of the Project.
- It is assumed that the Client provided all information to Shangoni that is relevant to the scope of work included in this technical report and that no important information has been withheld.

- The relevant information received from the Client during the course of this project will be deemed true and correct. If such information reflected in any documentation relevant to this project is discovered to be misleading, Shangoni does not take any responsibility for the implications of such misrepresentations made by the Client.
- Shangoni is under no obligation to the Client and others to conduct work not specified in the scope of work as agreed in the relevant proposal.
- Storm water control recommendations are based on industry experience and best practice. Final designs for construction should be authorised by an approved engineer.
- Contour and elevation data as provided during the analysis are assumed to be accurate and representative of the site and catchment areas.
- There is no storm water quality data available for storm water runoff associated with the haul roads and conveyors.
- Upstream catchment activities are interpreted according to common practices and no detailed insight is available on possible storm water measures beyond the site. The assessment does not guarantee the integrity of downstream infrastructure in the event of release or discharge from site.
- The measures proposed as part of the storm water management section of the report do not impose preference as this is an operational document to assist in the complete management of clean and dirty surface water in the vicinity of the operation.
- The measures proposed in the storm water management plan section of the report do not specifically cover considerations relevant to storm water management for the purpose of safety, like flooding and loss of life; the primary focus being environmental management and the identification of potential environmental concerns.

1 Introduction

1.1 Study background

Shangoni Management Services (Pty) Ltd. ("Shangoni") was appointed by De Beers Consolidated Mines (Pty) Ltd: Venetia Mine ("Venetia Mine") to compile a Surface Water Assessment ("SWA") in support of the proposed Venetia Mine Storm Water Management Project ("the Project"). The Project was undertaken to fulfil the requirements of the Environmental Impact Assessment ("EIA") and Water Use Licence Application ("WULA"). Venetia Mine is an existing opencast diamond mine located approximately 80 km west of Musina and 40 km north-east of Alldays in the Limpopo Province. The Mining Right Area ("MRA") is approximately 3 000 ha in extent and is surrounded by the De Beers-owned Venetia Limpopo Nature Reserve ("VLNR") comprising 36 000 ha. Construction at Venetia Mine commenced in January 1990, and the mine was officially opened on 14 August 1992. Full-scale mining was operational from 1993.

The ore body mined at Venetia Mine comprises three adjoining Kimberlite pipes, namely K01, K02 and K03. As the depth of open pit mining increases, the amount of waste rock increases and opencast mining becomes economically and environmentally unviable. Accordingly, Venetia Mine is currently undertaking a sizeable venture to convert the mine from an open pit operation to an underground mine, referred to as the Venetia Underground Project ("VUP"). Open pit mining is expected to continue until the end of 2021 and production in the underground mine is scheduled to commence in 2022 and will continue to 2043. The opencast pit will be developed to a maximum depth of approximately 450 m, where after, the K01 and K02 reserves will be mined from underground as part of the VUP. The VUP consists of two vertical shafts (production and services), a decline and associated infrastructure. No significant changes to the ore processing plant or the treatment process is anticipated.

1.2 Project Description

In preparation for the transition from an open pit mining operation to an underground mine, Venetia Mine has identified the need to construct additional storm water management infrastructure and containment facilities and to expand some of the existing facilities. Venetia Mine commenced with conceptual storm water management studies in 2011, and subsequently included the required storm water infrastructure into the Integrated Water Use Licence ("IWUL") amendment application in 2014. Since 2014, various studies have been undertaken, including water balance updates to better inform the detailed designs, capacities, and locations of the proposed dirty water containment facilities and associated infrastructure.

Jones & Wagner updated the GoldSim water balance for Life of Mine ("LOM") in 2020 in a report titled *De Beers Consolidated Mines: Venetia Mine Water Balance - Life of Mine and Scenario Report*, dated August 2020 (referred to as the "2020 Water Balance" hereafter). The 2020 Water Balance concluded that should Venetia Mine not increase re-use and recycling on mine by 40%, reduce the freshwater intake from the wellfields and not store any additional water on the Fine Residue Deposits ("FRDs") (allowable storm surcharge volume of 320 000 m^3), the required baseline storage for contaminated water is 2.11 Mm^3 (inclusive of the 780 000 m^3 surface storage requirement for the VUP). To reduce the overall storage requirement of 2.11 Mm^3, it was recommended that recycling be increased with 40% (440 000 m^3), reducing the storage requirement to 1.83 Mm^3. Based on the recommendations of the Engineer of Record ("EOR"), an allowable storm surcharge volume of 320 000 m^3 could be retained temporarily, over, and above normal operational levels on the FRDs. This surcharge volume further reduces the storage requirement with 365 000 m^3 to 1.465 Mm^3/a. To achieve the additional storage requirement of 1.465 Mm^3/a, Venetia Mine considered various storage alternatives to limit the risk of spillage to less than once in 50 years on average, in accordance with Regulation GN 704.

In addition to the 2020 Water Balance, Jones and Wagner evaluated various alternatives as a mine wide solution for the containment of contaminated storm water on site and for the separation of clean and dirty water runoff to ensure legal compliance in a report titled *Venetia Stormwater Management Project - Conceptual Evaluation of Polluted Water Storage Options,* dated 28 September 2020 (referred to as the "Alternatives Assessment" hereafter). Based on the 2020 Water Balance and the Alternative Assessment, the following the recommended go-forward options for the Project is proposed (please refer to Figure 1 below for the proposed layout plan of the Project):

- Pollution Control Dam ("PCD") 3:
  - PCD 3 is the main containment facility proposed for the Project and will be the first facility to be constructed in order to de-risk the VUP and to ensure compliance with the requirements of Regulation GN 704. PCD 3 will be constructed to the west of the mine adjacent to the Course Residue Deposit ("CRD") and will have a capacity of 1 050 000 m^3. This facility will be constructed to contain affected runoff from the upstream catchment inclusive of runoff from the CRD, FRD 1, the processing plant, the treatment plant, the recovery plant, and potential overflow from the other upstream water containment facilities (i.e., Southern Seepage Dam ("SSD") and FRD 1 RWD). The facility will also be constructed to contain water as removed from the opencast pits and the VUP underground workings once the available capacity within the On-Mine Water Storage Dams ("OMWSD") are exceeded.
- PCD 1:
  - PCD 1 will be constructed south of the existing Storm water Control Dams (Dam 1 and Dam 2) ("SWCD"), and it will have a capacity of 102 000 m^3. The facility will be constructed to collect and contain affected water runoff from the VUP surface area, crusher area, main offices, and workshops.
- PCD 2:
  - PCD 2 will be constructed to the north-west of the plant area (south-east to the FRD 1 RWD) and will have a capacity of 130 000 m^3. PCD 2 will be constructed as a containment facility and will receive affected runoff, water as removed from the opencast pit, the underground operation, and other facilities where capacity is required.

- PCD 1 Compartment 4B:
  - According to the Alternative Assessment report, PCD 1 Compartment 4B should have a capacity of 34 000 m^3 and will be constructed north-west of the existing SWCD to provide additional storage capacity. It will receive runoff and water as removed from the opencast pit and underground operation.
- Fine Residue Deposit ("FRD") 1 Return Water Dam ("RWD") expansion:
  - FRD 1 RWD is an existing facility located south-east of FRD 1 with a capacity of 27 500 m^3. The facility currently receives water from the FRD 1 via penstock, treated effluent from the sewage plant and a small portion of the upstream catchment adjacent to the opencast pit. It therefore jointly operates as a RWD and as a PCD, which means that the facility is mostly operated at or near full capacity and during heavy rainfall events, affected water may spill from this facility. Accordingly, FRD 1 RWD will be expanded to increase its storage capacity. The dam walls of FRD 1 RWD will be raised by 3 m to increase its capacity from 27 500 m^3 to 155 000 m^3.
- On-mine Water Storage Dam North and South ("OMWSD-N&S") expansion:
  - OMWDS-N&S are existing facilities located south of the SWCD with a capacity of 460 000 m^3. OMWSD-N&S receive water from the opencast pits, the plant, and the Well Fields (it will also receive water from the VUP in the future). In order to provide the required additional storage capacity, the combined storage capacity of these facilities will be increased from 460 000 m^3 to 555 000 m^3 by raising the dam walls with 2 m.
- OMWSD Compartment 3 ("OMWSD-3"):
  - OMWSD-3 is a new proposed facility that will be constructed directly north of the OMWSD-N&S with a capacity of 239 000 m^3. The facility will be constructed to contain water from the opencast pits, the plant, the underground mine, and the Well Fields.
- OMWSD Compartment 4 ("OMWSD-4"):
  - OMWSD-4 is a new proposed facility that will be constructed south-east of the exiting OMWSD-N&S and will occupy a portion of the existing storm water Attenuation Facility (also referred to as the storm water detention dam). OMWSD-4 will have a capacity of 192 000 m^3 and will be constructed to contain water from the opencast pits, the plant, the VUP and the Well Fields.
- K03 Pit:
  - K03 Pit is the smallest existing opencast pit. As the ore reserves associated with the K03 Pit have been mined out, it is proposed to use the pit as a dirty water containment facility. Mine water as removed from the VUP underground mine will be pumped to K03 Pit before being pumped to the other facilities for containment and reuse. K03 Pit has the capacity to contain 3.5 Mm^3 of water, however, it is anticipated that a volume of 780 000 m^3 of water removed from the underground mine will be stored within the pit.

- Relocation of the mine boundary security fence and re-routing of an 11 kV and 22 kV powerline:
    - Mine security fence - As PCD 3 will extend beyond the current Venetia Mine security fence, it is required to relocate the security fence around the boundary of PCD 3.
    - 11 kV powerline - An 11 kV mine powerline traverses the proposed PCD 3 area that will require relocation to direct the powerline around PCD 3.
    - 22 kV powerline - A 22 kV mine powerline traverses the proposed PCD 1 area that will require relocation to direct the powerline around PCD 1.
- Southern access road:
    - The southern access road will be upgraded and expanded to a 10 m wide road (currently 4 m wide) to provide access for construction vehicles to the proposed PCD 3 locality.
- Construction of storm water management infrastructure including channels and trenches:
    - Storm water management infrastructure, inclusive of channels and trenches will be constructed to divert affected water runoff to the existing and proposed above mentioned facilities.
    - Venetia Mine also proposes to construct a seepage collection trench along the western boundary of FRD 1 and FRD 2 to collect any seepage that may occur from the FRDs and direct such to either the FRD 2 RWD or the existing SSD. The SSD can then discharge affected water into PCD 3.
    - Venetia Mine also proposes to construct a Northern Seepage Collection trench that will collect seep from the waste rock dump to the north of the mine. The collected seep water will be pumped to FRD 2 RWD for containment.
- Provision of pipelines and pumping systems:
    - Pump stations will be constructed, and a pipeline network established to allow for efficient water reticulation and re-use of water between the existing and proposed water storage facilities.
- Mine water discharge:
    - Venetia Mine proposes to discharge surplus water to the receiving environment, not only as means of managing surplus water but also to ensure safety in the underground workings of the VUP. Current storm water runoff modelling and water balance assessments indicate that on average a volume of 46 000 m^3 will be discharged annually and during a 1:50-year flood event, a total volume of 792 000 m^3 will be required to be discharged. The discharge of affected water will only be conducted should there be insufficient storage capacity and in accordance with the relevant approvals (Environmental Authorisation and WUL). Should such a discharge be necessary, it will occur from PCD 3 and / or the OMWSD-NS. A separate WUL application will be submitted for the proposed activity.

1.3 Objectives and Methodology

A site visit was conducted in April 2021 with the following purpose:

- To obtain an understanding of the study area and surroundings;
- To define the characteristics of surface runoff drainage patterns in the area;
- To obtain an understanding of the affected sub-catchment i.e., the size, shape and slope;
- To obtain an understanding of the practical implications of the Project regarding managing storm water;
- To examine the location of all existing and proposed dirty water containment infrastructure;

The main objective of this SWA is to assess the impacts on surface water quality and quantity associated with the Project, and to evaluate the proposed measures to contain affected water and to ensure clean and dirty water separation to meet the requirements in accordance with the best practice guidelines (DWAF, 2006), Section 19 of the National Water Act and Regulation GN 704 (No. 704 of 4 June 1999) of the National Water Act (Act 36 of 1998). The SWA is a high-level strategic document presenting a combination of existing and proposed practises with focus on storm water control measures to be implemented at the Project (as already determined by the Jones & Wagener study).

1.4 Legal Framework

1.4.1 National Water Act (No. 36 of 1998)

Storm water management for the Venetia Mine falls under legislation contained in, amongst others, the National Water Act (No. 36 of 1998). Part 4 deals with prevention and contamination, and in particular, the situation where pollution occurs or might occur as a result of activities on land: *The person who owns, controls, occupies or uses the land in question is responsible for taking measures to prevent pollution of water resources. If these measures are not taken, the catchment management agency concerned may itself do whatever is necessary to prevent the pollution or to remedy its effects, and to recover all reasonable costs from the persons responsible for the pollution. This can be summarised as follows:*

- Separate "clean" and "dirty" water;
- Water contaminated by activities / infrastructure may not be discharged to surface or groundwater resources; and
- Prevention of erosion.

1.4.2 Extracts from the National Water Act (No. 36 of 1998), Part 4

(1) An owner of land, a person in control of land or a person who occupies or uses the land on which

(a) any activity or process is or was performed or undertaken; or

(b) any other situation exists, which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring.

(2) The measures referred to (above) may include measures to –

(a) cease, modify or control any act or process causing the pollution; *(b) comply with any prescribed waste standard or management practise;* *(c) contain or prevent the movement of pollutants;* *(d) eliminate any source of pollution;* *(e) remedy the effects of pollution;* *(f) remedy the effects of any disturbance to the bed and banks of a watercourse.*

1.4.3 Regulations relating to capacity requirements of "clean" and "dirty" water systems

Every person in control of an activity must – *(a) confine any unpolluted water to a clean water system, away from any dirty area;* *(b) collect the water arising within any dirty area, into a dirty water system;* *(c) design, construct, maintain and operate any dirty water system so that it is not likely to spill into any clean water system more than once in 50 years.*

Regulation 6 and 7 of GNR 704 in terms of the National Water Act regulate the capacity requirements of clean and dirty water systems and the protection of water resources on and around mining and related operations respectively and requires that: *"Every person in control of a mine or activity must confine any unpolluted water to a clean water system, away from any dirty area; and design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years" and "Every person in control of a Mine or activity must take reasonable measures to prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or purification and disposal in terms of the Act.*

Figure 1: Venetia Storm Water Management Project - Master Layout Plan.

2 Description of the environment

2.1 Regional location and immediate surroundings

Venetia Mine is located in the Limpopo Province approximately 80 km west of Musina and is positioned near South Africa's northern border with Botswana and Zimbabwe. Venetia Mine is situated within the Musina Local Municipality and the Vhembe District Municipality and falls within the buffer zone of Mapungubwe National Park (a world heritage site). Venetia's wellfields are located to the north of the mine, within the core of Mapungubwe National Park, and the servitude to the mine runs through the park and the VLNR. Venetia Mine is situated on the farm Venetia 103-MS and can be most easily accessed via the R521 provincial road running between Alldays and Musina. Please refer to Figure 2 below for the regional setting of Venetia Mine.

Surrounding towns and settlements include the following of which distances were measured by drawing a straight line from the centre of the Venetia opencast pit:

- Alldays - 35 km south-west;
- Musina - 75 km east;
- Louis Trichardt - 90 km south-east;
- Thohoyandou – 130 km east by south-east; and
- Polokwane – 160 km south.

Venetia Mine is situated in the Limpopo River primary catchment area and within A63E quaternary catchment (refer to Figure 3 below). The mine is located within the Limpopo water management area and falls within the regional authority of the Department of Water and Sanitation's ("DWS") Limpopo regional office.

Venetia mine is located within the Savanna Biome and the Mopane Bioregion. More specifically, the local region comprises two ecological types described by Mucina and Rutherford (2006) as the Musina Mopane Bushveld (SVmp1) and Limpopo Ridge Bushveld (SVmp2). The conservation status of both these units is indicated as 'Least Threatened' providing insight into the low local and regional transformation status.

The regional geology is dominated by the Limpopo Belt, which is located between the Kaapvaal and Zimbabwe Cratons. The Limpopo Belt comprises three zones i.e. Northern Marginal, Central and Southern Marginal and is a very complex geological province shaped by many tectono-metamorphic events. The Venetia Mine is situated in the Central Zone of the Limpopo Mobile Belt (Swazian Era). The Limpopo Belt in the Venetia Mine area is believed to be 10 km thick and contains an ensemble of rocks known as the Beit Bridge Complex that comprises rocks of the Gumbu, Malala Drift and Mount Dowe Groups. This country rock at Venetia Mine comprises mainly quartzofeldspathic gneisses, marbles, gneisses, shists and other metasediments. At the Venetia Mine, kimberlite pipes are surrounded by four tectonic units. These units include the Gotha Granitic Complex, the Venetian Klippe, the Endora Klippe and the Krone Metamorphic Terrane. The diamond bearing Venetia Kimberlite Cluster consists of a series of pipes and dykes that intruded the core of the synformal fold. The kimberlites are named in terms of their volumetric abundance i.e. K01 is larger than K02 and K02 is larger than K03, and so forth.

Three main soil units are present at Venetia Mine, including:

- Unit A: Unit A refers to yellow and red soils without water tables and belonging in one or more of the following soil forms: Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly. In Ae (red-yellow apedal, freely drained soils, red high base status, 450 – 700 mm deep, no dunes) and Ah (red and yellow, high base status), yellow soils occupy less than 10 % of the area while dystrophic and/or mesotrophic soils occupy a larger area than high base status red-yellow apedal soils. Resultant soils are generally poorly suited for arable agriculture and clay contents are generally lower than 15 %. Soil depths vary between 450 and 750 mm.
- Unit D: Units Da – Dc accommodates land where duplex soils are dominant, indicating a high erodibility, containing dominant prismacutanic and/ or pedocutanic diagnostic horizons and where the B horizons are generally not red. Upland soils that display duplex character include Estcourt, Sterkspruit, Swartland, Valsrivier and Kroonstad forms. Db refers to land where duplex soils with non-red B horizons comprise more than half of the area covered by duplex soils. Soils in these areas, despite comparatively deep (> 750 mm) are of intermediate suitability for arable agriculture where the climate permits.
- Unit F: Unit F mainly includes Glenrosa and/ or Mispah forms (predominantly stony, rocky, but other forms may also occur) and is intended to accommodate pedologically young landscapes that are not predominantly rock and not predominantly alluvial or aeolian and in which the dominant soil forming processes have been rock weathering, the formation of orthic topsoil horizons and, commonly, clay illuviation, giving rise typically to lithocutanic horizons. Fc refers to land where lime occurs regularly (there do not need to be much of it, and it need not occur in every soil present) in upland and valley bottom soils. Soil depth is generally less than 450 mm clay percentage is less than 15 %. Resultantly soil potential is of intermediate suitability for arable agriculture where the climate permits.

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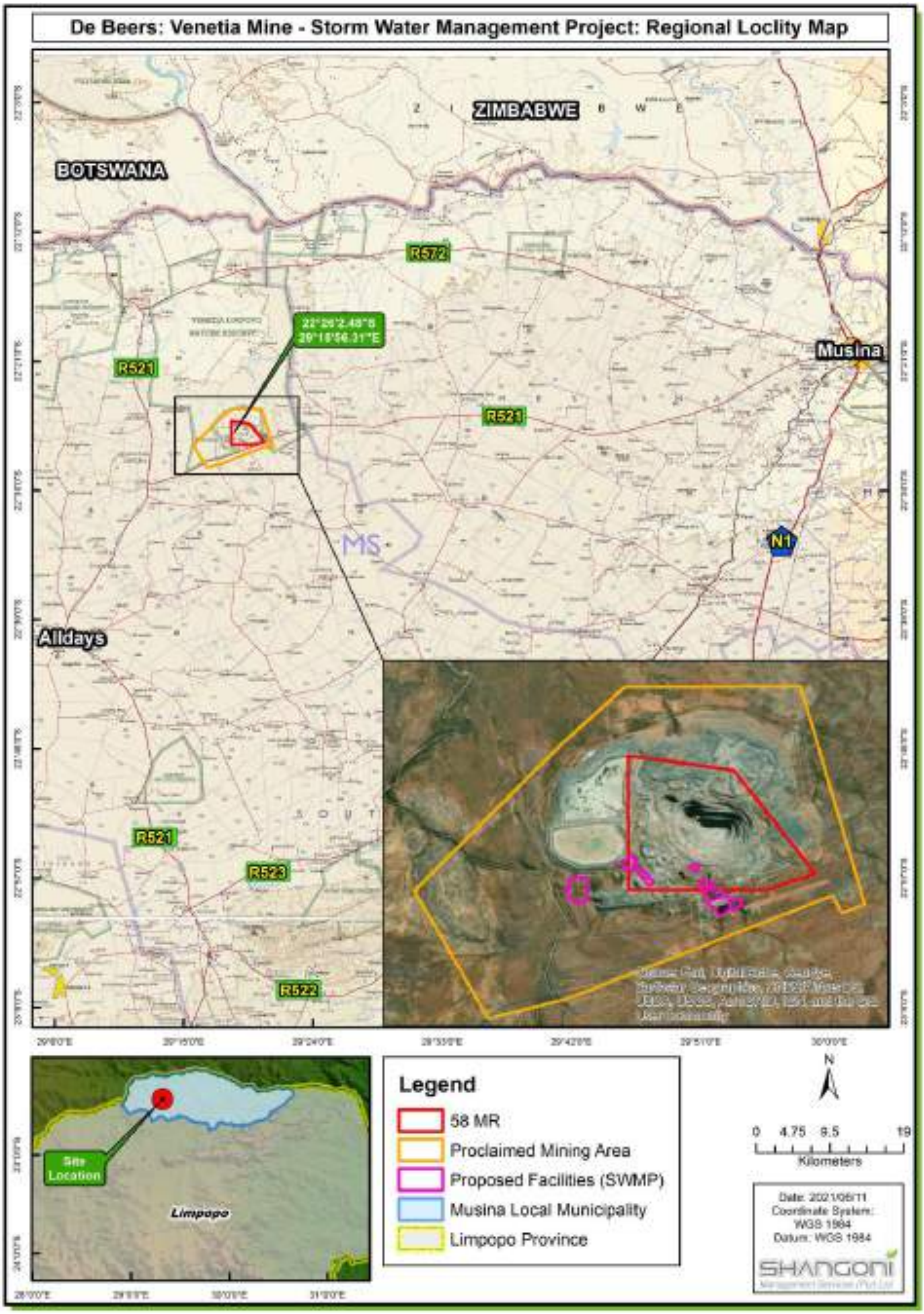


Figure 2: Regional Locality of Venetia Mine.

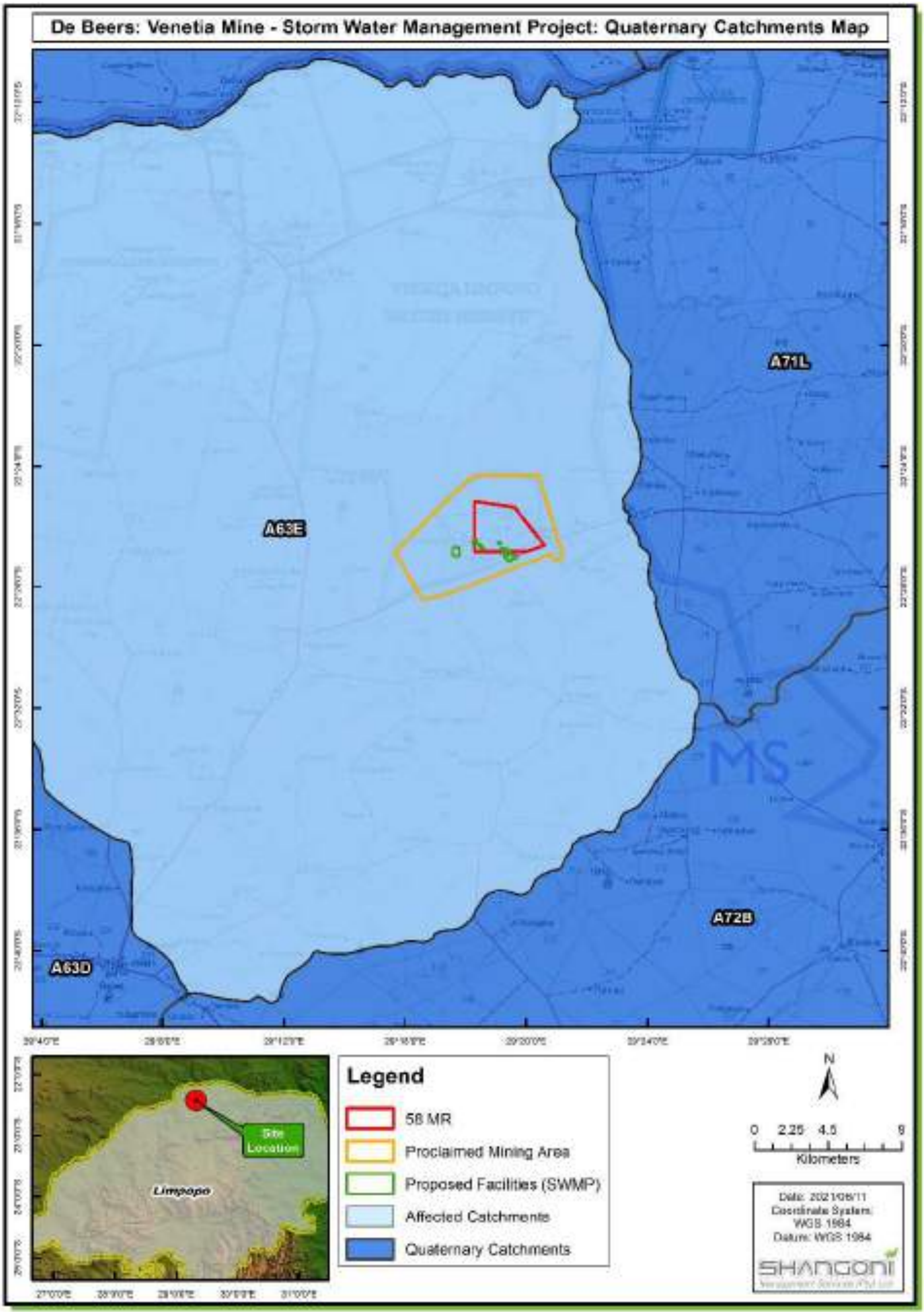


Figure 3: Quaternary catchments associated Venetia Mine.

2.2 Topography and drainage

Topography is a key feature in the assessment and design of a SWMP as it contains the critical direction and speed of surface water runoff. Shuttle Radar Topography Mission ("SRTM") - 1 Arc-Second derived topography data was sourced from the United States Geological Survey ("USGS") Earth Explorer Website. The SRTM data was interpolated to 5 m surface contours and used to assess the regional topography and drainage. The regional topography associated with Venetia Mine is a mixture of terrains consisting of low hills and wide valleys, varying in elevation from 700 m above mean sea level ("mamsl") in the south to 600 mamsl at the topographical lows in the north. Situated approximately 10 km south of Venetia Mine is the Soutpansberg mountain range with an average elevation of approximately 800 mamsl. The Limpopo River is situated approximately 30 km north of Venetia Mine at an average elevation of 500 mamsl. The regional topography associated with Venetia Mine slopes in a north to south direction from the Soutpansberge towards the Limpopo River.

The Limpopo River is joined by several tributaries in the vicinity of Venetia Mine, namely the Setonki, Kolope and Matotwane Rivers. Activities at Venetia Mine have effects on the catchments of the Matotwane and Kolope Rivers (bordering the mine) and on the Limpopo River (downstream of the mine). The Kolope River is located along the western boundary of the mine and flows northwards through the western corner of the Venetia-owned property. The Kolope is a non-perennial river and flooding does not bare consequence to the mine, due to its location outside of the mining area. The Matotwane River is a tributary of the Kolope River. It is located towards the eastern boundary of Venetia Mine and flows northwards where it meets with the Kolope River around 9.5 km north of the mine. A further 10 km north-east, the Kolope River joins with the Limpopo River. A floodline assessment conducted by SRK consulting services (SRK, 2007) determined that the mining activities fall outside of the 1:100-year floodlines for the Kolope and Matotwane rivers. Refer to Figure 4 below for a representation of the regional topography and drainage associated with Venetia Mine.

To assess the site-specific topography and drainage associated with the Project, interpolated surface contours (1 m) were provided by Venetia Mine. The surface topography of the area has permanently been altered by the mining activities, which will have a lasting effect on the surface topography, including the open pits and various Mine Residue Deposits ("MRDs"), including the Fine Residue Deposits ("FRDs"), Coarse Residue Deposit ("CRD") and Waste Rock Dumps ("WRDs'). These features have resulted in a fairy complex topography and associated drainage network at Venetia Mine. Numerous small drainage lines surround the periphery of the mine that drain into either the Kolope River or the Matotwane River. It has been noted that prior to the mining excavations, a small ephemeral streambed passed through the centre of the pit running from south to north and an authorised river diversion was constructed to divert runoff from the upstream catchment towards the Kolope River. Due to the development of the VUP, the decision was made to upgrade the river diversion to handle a 1:200-year flood event. The Van Zylsrust drainage line is located south of FRD 1 and drains into the Van Zylsrust Dam. Refer to Figure 5 below for an illustration of the site-specific topography and drainage and to Figure 6 for a 3D visualisation of the mine.

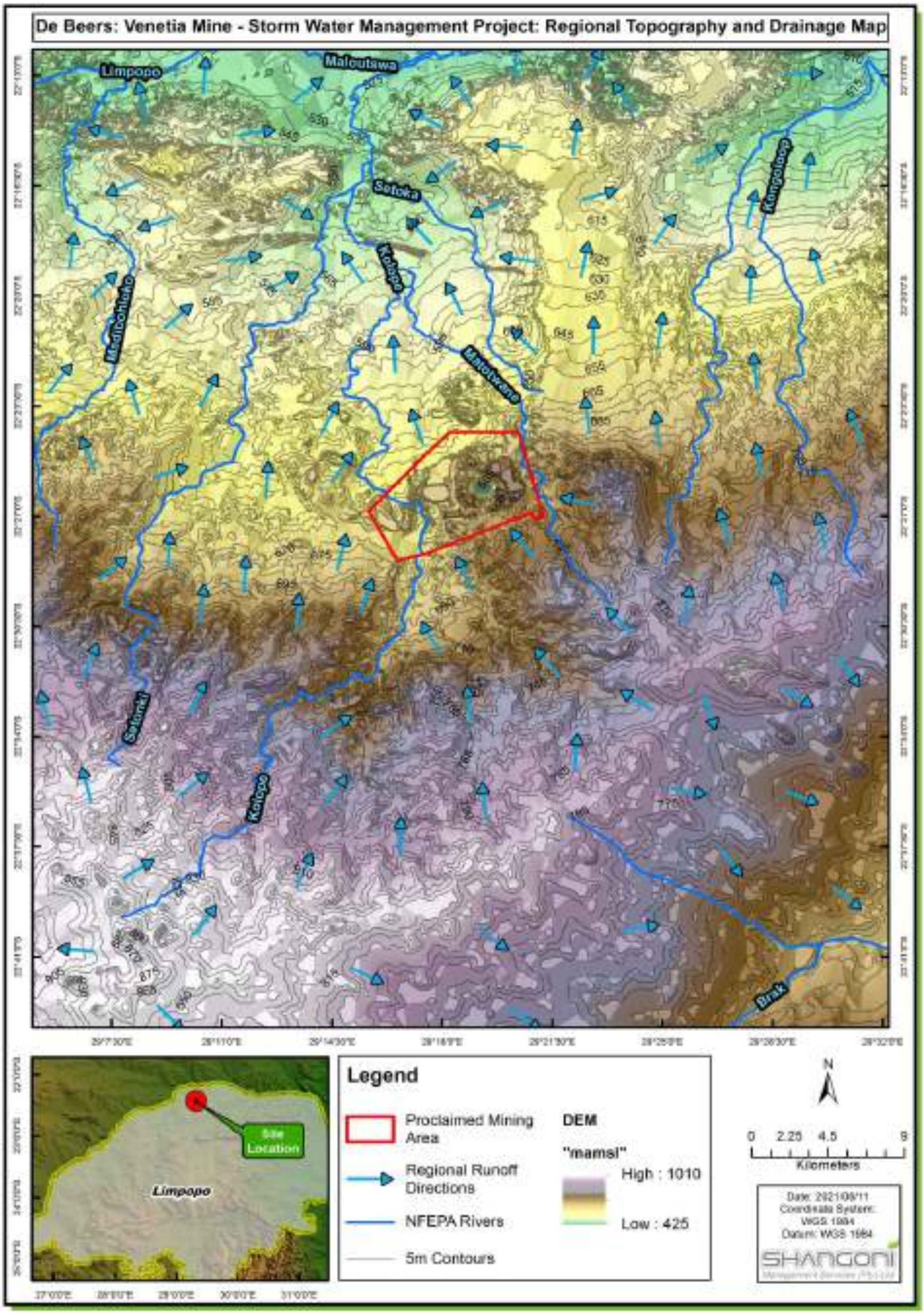


Figure 4: Regional topography and drainage associated with Venetia Mine.

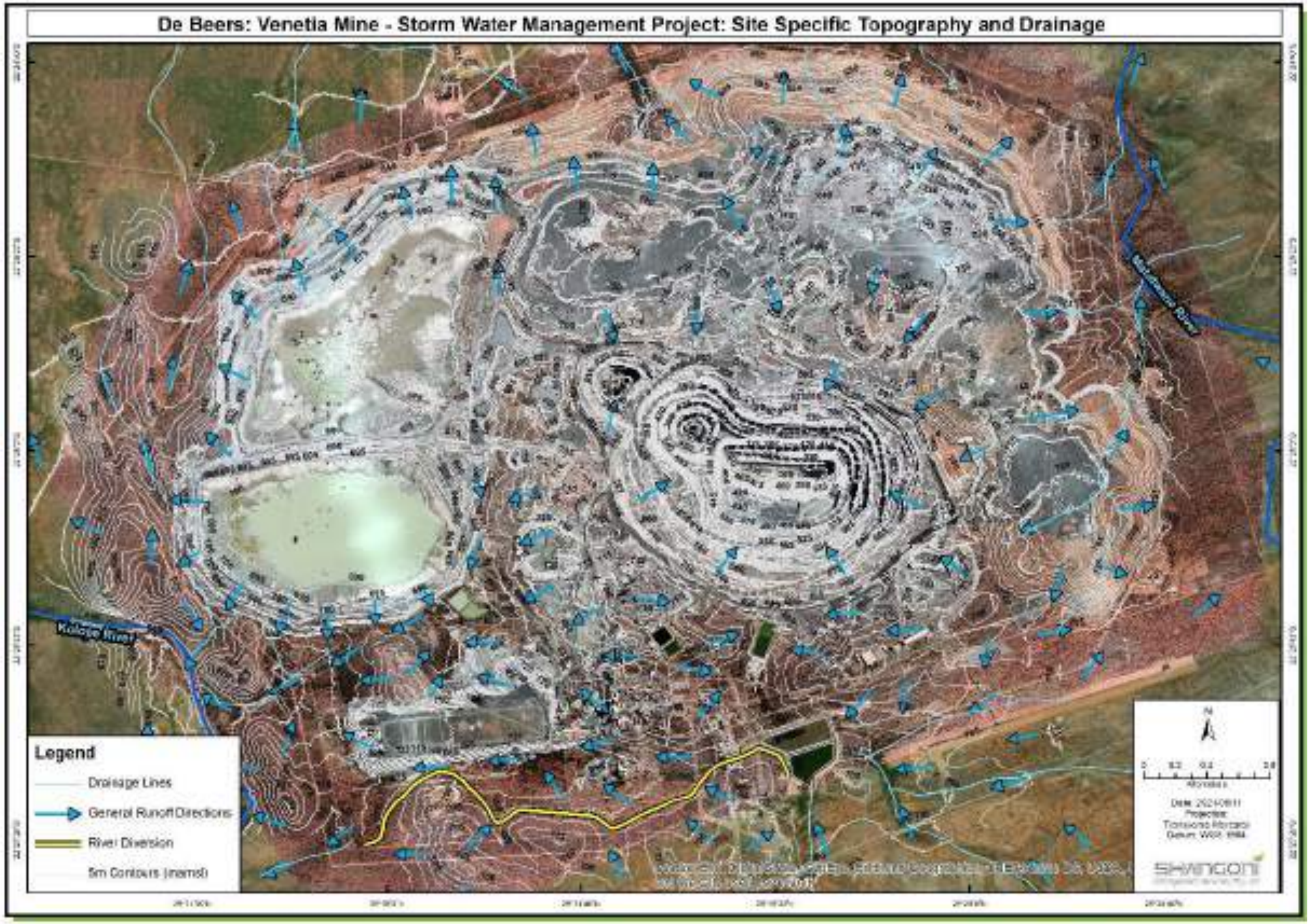


Figure 5: Site specific topography and drainage associated with Venetia Mine.

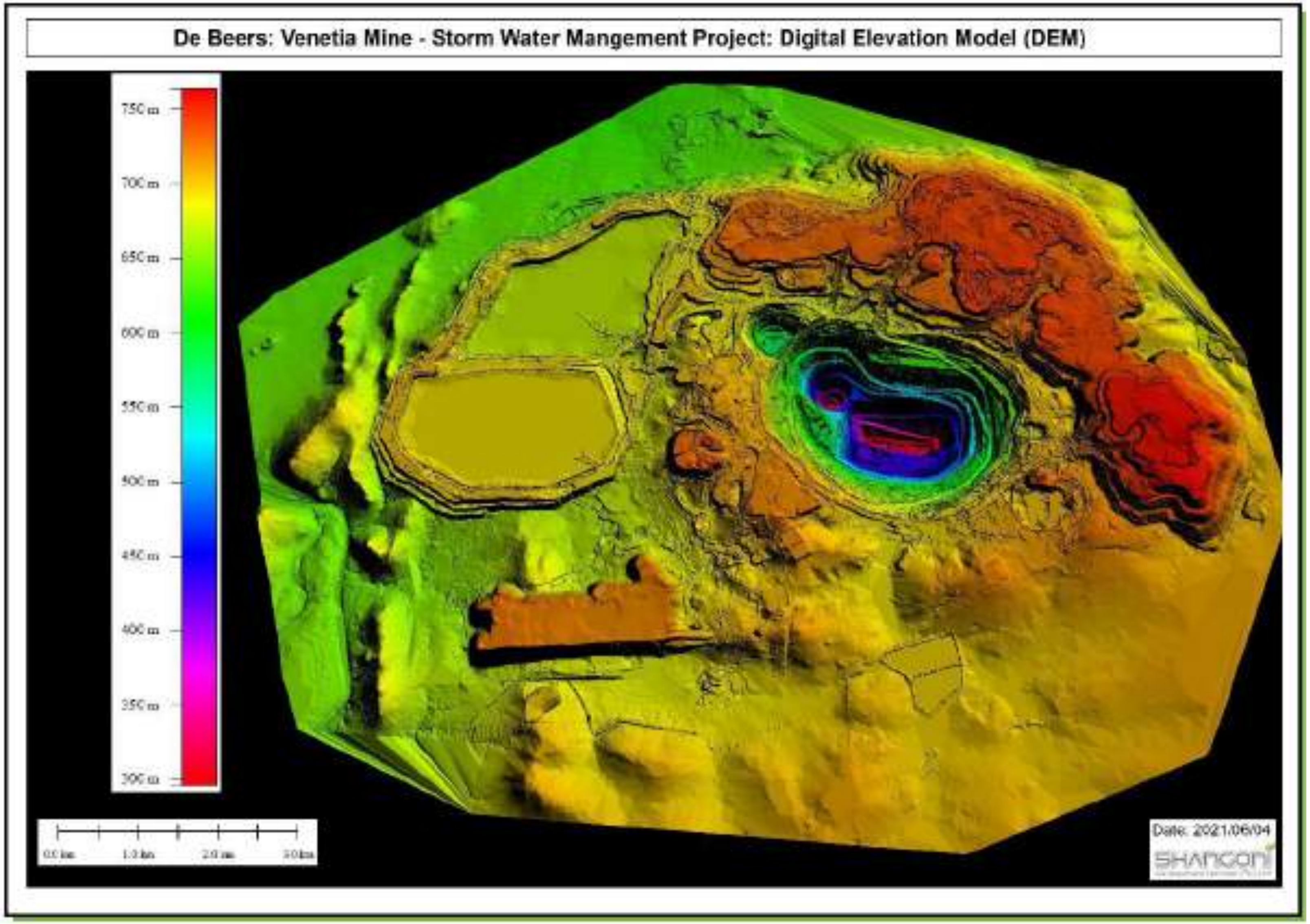


Figure 6: 3D visualisation of Venetia Mine

3 Hydrology

3.1 Precipitation and evaporation

Venetia Mine mostly experiences a sub-tropical climate. The site is, however, also located in the north-western half of Limpopo close to Botswana where the climate is semi-arid to arid in the southern parts. It may be suggested that the Venetia Mine is located in a transitional zone of the two different climatic zones. Rainfall is mainly driven by thunderstorms, occurring five days a month on average and most frequently result in less than 21 mm of rain.

In order to provide the most accurate rainfall record for Venetia Mine the same approach was taken as Jones and Wagner in their 2020 Water Balance update, *titled Venetia Mine Water Balance: Life of Mine and Scenario Report, dated August 2020 and prepared by Jones and Wagner Engineering and Environmental Consultants.*

On-site rainfall records were obtained from Venetia Mine and combined with records from the two closest rainfall stations, namely Alldays and Pontdrift (with records maintained and verified by the DWS). Recordings at Alldays and Pontdrift ceased in 1992 and 2009 respectively. Table 1 below shows a comparison of the mean annual precipitation ("MAP") between the on-site records and records from the two closest weather stations. The table shows that the MAP on-site (395 mm) was notably higher than the two nearest rainfall stations. This is likely due to the shorter length in records and a period of extreme rainfall experienced in January 2013, which equated to approximately a 1:200 year 7-day flood event, with more than the MAP falling over a 7-day period (i.e. 445 mm). The MAP at Alldays and Pontdrift is very similar at 360 mm and 357 mm respectively.

Due to the extreme rainfall recorded in January 2013 and the fact that rainfall measurements at the Pontdrift and Alldays stations ceased in 2009 and 1992 respectively, the decision was made to append the Pontdrift rainfall data to the Alldays data from 1993 onwards and then to utilise rainfall data, as measured on the mine, from 2009 to present, to create a long-term combined rainfall record for Venetia Mine. The combined record, therefore, consists of Alldays data from 1930 to 1992, Pondrift data from 1993 to 2009, and Venetia Mine data from 2009 to present. The MAP for the combined rainfall record was calculated at 365.11 mm and is thought to provide the most accurate rainfall representation at Venetia Mine. The average monthly precipitation calculated from the combined rainfall record is represented in Figure 7 below. It is clear that precipitation at Venetia Mine shows a seasonal pattern with the highest rainfall occurring between November and March and very little precipitation occurring between May and September.

Evaporation data was sourced from WR1990 ("Surface Water Resources of South Africa 1990", published by the Water Research Commission). Although there has been a subsequent update to this study in 2012 (i.e., WR2012), the factors relating to evaporation remained unchanged in the 2012 update. In summary, Venetia Mine is located within Evaporation Zone 1B that relates to a Mean Annual Evaporation ("MAE") of 2050 mm for an S-Class pan.

Table 1: Comparison of the MAP between the available resources.

Station Number	Station Name	MAP (mm)	Proximity to the site (km)	Length of records (years)	Years of available data
On Site	Venetia Mine	395	0	22	1999-2020
0808253_W	Pontdrift	357	30.5	44	1966-2009
0764161_W	Alldays	360	36	63	1930-1992

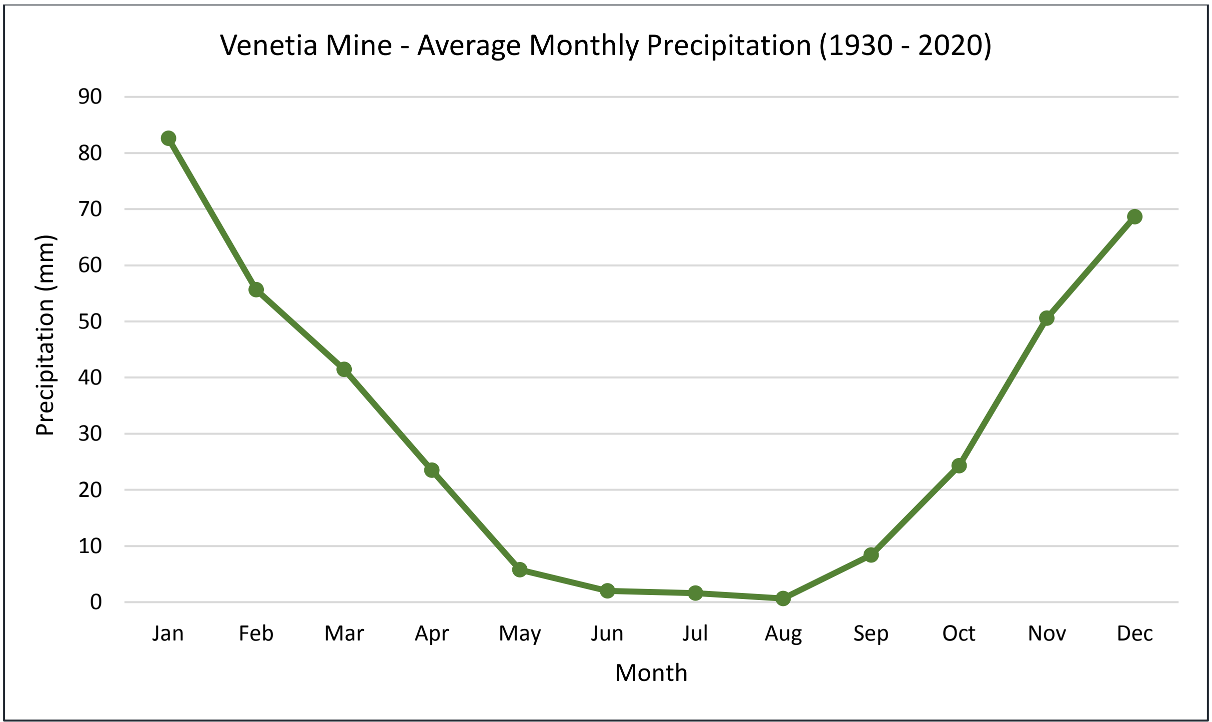


Figure 7: Average monthly precipitation at Venetia Mine (1930 – 2020).

4 Water Balance Modelling

The information in this chapter was extracted from the *Venetia Mine Water Balance - Life of Mine and Scenario Report*, dated August 2020 and prepared by Jones and Wagner Engineering and Environmental Consultants.

In order to determine the appropriate storage requirements for the proposed new water storage facilities and the proposed expansions to existing facilities (as per Regulation GN 704), GoldSim systems modelling software was utilised, with the use of Excel as a database for inputs and outputs. The model was developed as an operational and forecasting dynamic model and was updated from the previous water balance done in 2014. All relevant data was retained, and outdated data or assumptions were updated.

Daily rainfall data was used as an input to the model, using historical data from the Alldays and Pontdrift rainfall stations, together with mine data (refer to Chapter 3). The site was delineated into various catchments according to similar runoff characteristics for the open pit LOM. A daily rainfall-runoff simulation was utilised to generate runoff and evaporation values. A stochastic rainfall module was incorporated into the model, calibrated against the historical rainfall dataset, therefore allowing for the performance of statistical assessments in the water balance, such as for dam sizing. Inputs were imported into the model including inflow data (e.g., from the VUP, from the wellfields, from the sewage plants, seepage, runoff, rainfall etc.), catchment areas, historical and LOM tonnages, as well as underground water requirements and timing.

The water balance for Venetia Mine was done through three main steps. Firstly, the status quo baseline water balance was calibrated, as far as practically possible, against measured data, where available. This was done to ensure a degree of confidence in the water balance model and that it provided an accurate representation of the site. The calibration period selected was from 2017 to 2019. Next, the baseline water balance for the LOM was developed, which included the transition from an open pit operation to an underground mine. The third step assessed the water balance for various different scenarios, which were not included in the baseline water balance. The effect of these scenarios was then quantified, assessed and the most appropriate storage options were selected.

In order to accurately account for surface water runoff, the GoldSim model used the United States Soil Conservation Services (“SCS”) runoff modelling algorithms, developed for South African conditions by the University of Kwazulu- Natal (formerly the University of Natal). The SCS modelling method considers the 30-day antecedent rainfall and evaporation values to account for antecedent soil moisture conditions. The SCS curve number was selected based on the soil and vegetation type for each catchment area. The runoff was either calculated using a factor applied to the rainfall or through the use of the SCS model. The GoldSim model then determined the appropriate dam sizing based on all the inflow and outflow parameters, inclusive of surface runoff. The containment capacity of all water storage facilities was modelled so that the risk of the dams spilling is less than 2% (i.e., less than once in 50 years on average), as per Regulation GN 704.

The GoldSim model did, however, not determine surface runoff volumes based on a discrete event (e.g., 1:50-year or 1:100-year flood event) as it utilised a stochastic daily model that calculated a runoff coefficient for each runoff receiving PCD catchment. This runoff value together with all other inflow and outflow values were then incorporated into the model to determine the required storge capacities that will limit spillages to less than 2% (i.e., less than 1 in 50 years on average). However, in order to provide an estimate of the runoff volumes expected to report to each runoff receiving PCD during a 1:50-year flood event, Jones and Wagner also utilised PSWMM software to model the volume of water that can be expected to report to each runoff receiving PCD during a 1:50-year flood event, the results of which are represented in Table 2 below.

Table 2: Expected runoff volumes for each runoff receiving PCD during the 1:50-year flood event.

	Runoff Volume (m^3)	Comments
SWCD	20 000 m^3	Excluding direct rainfall, water gravitating from PCD1, or water pumped from K03 Pit
PCD 1	43 000 m^3	Excluding direct rainfall.
PCD 3	323 000 m^3	Excluding direct rainfall, overflow from RWD 1 FRD.

5 Storm Water Management Plan Assessment

A Storm Water Management Plan for the Project was initially done in 2014, titled *Venetia Mine: Stormwater Management Plan, dated June 2014 and prepared by E-Consulting Environmental Engineers.* Since 2014, various additional studies have been undertaken, including water balance updates to better inform the detailed designs, capacities, and locations of the proposed facilities (i.e., the Project), and the Venetia Mine Storm Water Management Project PFS-A study that evaluated various alternatives and recommended the go-forward options for the Project. This chapter provides a detailed description of the proposed storm water management measures, as proposed by Venetia Mine and based on the above-mentioned studies, that aim to address concerns that have been identified in terms of capacity requirements to store affected water and proposed measures to separate clean and dirty water. This assessment is compiled in line with the Best Practise Guidelines G1 for Storm Water Management (DWAF, 2006), the National Water Act (Act No. 36 of 1998) and Regulation GN 704 (No. 704 of 4 June 1999) in terms of the National Water Act (Act No. 36 of 1998).

A catchment delineation was conducted as part of this SWA (refer to Figure 8 below) indicating the main catchment areas for each of the runoff receiving PCDs. Runoff receiving PCDs were defined as the containment facilities that will be constructed initially to collect and contain affected runoff generated on-site (i.e., PCD 3, and PCD 1) as well as the existing SWCD that currently receives affected runoff. It is noted that PCD 2 and PCD 1 Compartment 4B (if constructed) will also receive runoff in the future. This will however not impact the delineated affected sub-catchments, as a small portion of each sub-catchment reporting to PCD 3 and PCD 1 will be diverted to PCD 2 and PCD 1 Compartment 4B, respectively. When these two additional facilities are constructed, it will essentially only reduce the size of the sub-catchments reporting to PCD 3 and PCD 1.

In order to determine the sub-catchments that will report to each runoff-receiving PCD, distinct catchment boundaries were delineated using the geographic location of all recommended go-forward storage options and their associated infrastructure and interpolated 1 m contours provided by Venetia Mine. Each management area at the Project is discussed by indicating the main drainage philosophy anticipated using contour data and the proposed runoff control strategies. Blue and red arrows indicate the location of clean and affected runoff respectively as well as direction. A more detailed description of the storm water environment as well as the proposed measures to manage affected water is provided in the discussion table (Table 3) using the SWMP map (Figure 8) as a reference.

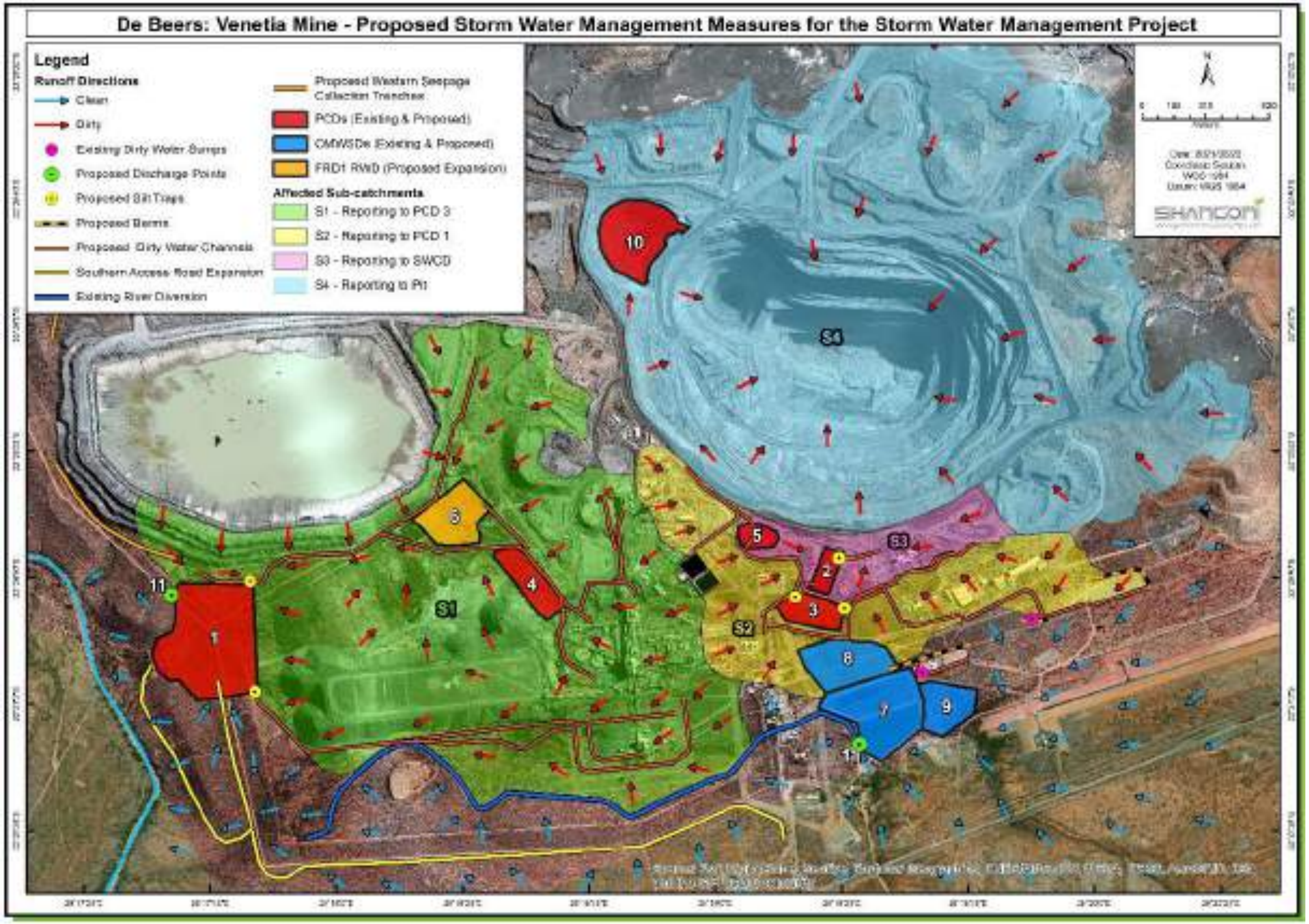


Figure 8: Proposed storm water management measures for the Project.

Table 3: The proposed Storm Water Management Plan[1].

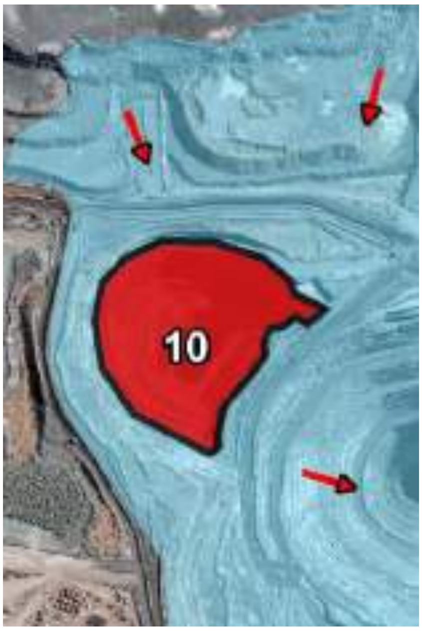
Reference number corresponding to Figure 8	Current & proposed strategies
	**<u>PCD 3 (1)</u>** A large sub-catchment (S1) was identified where affected water is generated during rainfall events from the main plant area, the recovery plant area, the CRD, the southern and eastern slopes of FRD 1, the valley between the CRD and FRD1, a portion of the ore stockpiles and the crusher area. S1 was delineated based on the geographic location of existing and proposed infrastructure and the on-site topography. PCD 3 is the main containment facility for the Project and will be the first facility to be constructed to de-risk the VUP and to ensure compliance with the requirements of Regulation GN 704. It will be constructed directly west of the CRD and will contain all runoff reporting to S1. <u>Problem statement</u> Currently, the majority of affected runoff reporting to S1 drains into the Van Zylsrust Dam or into the Kolope River, except for a small portion north in S1 where runoff drains into FRD 1 RWD via an unlined earth canal. However, during heavy rainfall events, affected water spills from FRD1 RWD into the Van Zylsrust drainage line via the SSD and then enters the Van Zylsrust Dam. In addition, seepage from the western boundary of FRD 1 and FRD 2 also currently drains into the receiving environment (except for seepage collected in the SSD). In order to comply with Regulation GN 704, all affected runoff reporting to S1 and seepage from the FRDs should be collected and contained in a facility capable of handling the volume of water associated with a 1:50-year flood event. <u>Recommended action</u> PCD 3 will be constructed to contain all runoff reporting to S1 and seepage from the FRDs. According to Jones & Wagner's 2020 Water Balance, PCD 3 should have a capacity of 1 050 000 m^3 in order to limit spillages to less than 2% (i.e., less than 1 in 50 years on average) in accordance with Regulation GN 704. In addition to surface runoff and seepage, PCD3 will also be constructed to contain water as removed from the opencast pits and the VUP. PCD 3 will cover an area of approximately 22.8 ha and will consist of 2 two-chamber sediment traps (at the northern and southern inlets) and a series of affected water channels to collect and convey all runoff reporting to S1 towards the PCD via gravity. A seepage collection trench will be constructed along the western boundary of FRD 1 and FRD 2 to collect any seepage that may occur from the FRDs and direct such to either the FRD 2 RWD or the existing SSD. The SSD can then discharge affected water into PCD 3 via an affected water channel connected to the facility. These measures will ensure that all affected runoff reporting to S1 and seepage from the FRDs is collected and contained in a facility with capable of containing the 1:50-year flood event, as required by Regulation GN 704.

[1] These storm water management measures are proposed by Venetia Mine based on several studies that were conducted to better inform the detailed designs, capacities, and locations of the Project, including the original Storm Water Management Plan (ETek, 2014), both water balance studies (i.e., Jones & Wagner, 2014 and Jones & Wagner 2020), and the polluted water storage alternatives assessment (Jones & Wagner, 2020).

Reference number corresponding to Figure 8	Current & proposed strategies
 	**SWCD (2)** The SWCD is an existing PCD located directly south of the open pit. Currently all affected runoff reporting both to S2 and S3 is contained in the SWCD in addition to dewatering from the pit. This facility has a storage capacity of 27 500 m^3 and covers an area of approximately 1.6 ha. Problem statement Currently, the SWCD has insufficient capacity to contain the volume of runoff reporting to both S2 and S3 during a 1:50-year flood event (Jones & Wagner, 2020). Due to the need for the SWCD to contain runoff from both S2 and S3, and water from the pit, it is mostly operated at or near full capacity. During heavy rainfall events water overflows, resulting in ponding of affected water in the surrounding area or affected water draining into the downstream environment. Currently this facility is not fully compliant with the requirements of Regulation GN 704 in terms of its capacity to contain affected runoff. Recommended action It is proposed to construct an additional PCD facility to contain a portion of the runoff currently reporting to the SWCD. The construction of PCD 1 will reduce the current catchment area associated with the SWCD from approximately 129 ha to 31 ha (approximately 76% reduction). Reducing the catchment size will reduce the amount of runoff reporting to the SWCD, providing additional storage capacity for pit dewatering. It will also ensure that the facility has the capacity to contain the volume of runoff expected to report to it during a 1:50-year flood event in accordance with Regulation GN 704.
	**PCD 1 (3)** PCD 1 is a proposed facility that will be constructed directly south of the SWCD at a slightly higher elevation. A sub-catchment (S2) was delineated based on the proposed location of PCD 1, its associated affected water channels and the on-site topography, that will collect and convey affected runoff from the VUP surface area, crusher area, main offices and workshops towards PCD 1. Problem statement As mentioned above, the existing SWCD has insufficient capacity to contain the volume of runoff reporting to both S2 and S3 during a 1:50-year flood event. In order to meet the requirements of Regulation GN 704, an additional PCD is required to contain a portion of the affected runoff that currently reports to the SWCD. Recommended action PCD 1 will be constructed to provide additional storage capacity of affected water and reduce the volume of runoff currently reporting to the SWCD. Based on the results from Jones & Wagner's 2020 Water Balance, PCD 1 should have a capacity of 120 000 m^3 in order to contain all runoff reporting to S2 and limit spillages to less than 2% (i.e., less than 1 in 50 years on average) in accordance with Regulation GN 704. PCD 1 will cover an area of approximately 4.3 ha and consist of 2 two-chamber sediment traps (at the western and eastern inlets) and a series of affected water channels to collect and convey affected runoff towards the PCD via gravity. PCD 1 will be constructed at a slightly higher elevation than the existing SWCD, allowing for water transfers to be done via gravity

Reference number corresponding to Figure 8	Current & proposed strategies
	into the SWCD from where it can be pumped into the Venetia Mine water reticulation system.
 	**<u>Proposed additions and expansions to dirty water containment facilities</u>** <u>Problem statement</u> As mentioned previously, Venetia Mine, as part of the Jones and Wagener Water Balance, has identified the need to construct additional storm water management infrastructure and containment facilities and to increase the storage capacity of existing facilities. Additional storage capacity will be essential to de-risk the VUP and to enable Venetia Mine to increase the re-use and recycling of water on mine, to reduce the freshwater intake from the wellfields and to contain affected runoff generated on-site. <u>Recommended action</u> In order to provide the much-needed additional water storage capacity, it is proposed to construct four additional contaminated water storage facilities and to increase the storage capacity of two existing facilities. Importantly, none of these water storage facilities will receive any surface runoff directly, rather, they will function as "pump-to" facilities only, each equipped with pumping infrastructure from where affected water can be pumped to or from, depending on the situational requirements. PCD 2 **(4)** is a proposed new facility that will be constructed north-west of the plant area and south-east of FRD 1 RWD. Based on Jones & Wagner's 2020 Water Balance, PCD 2 should have storage capacity of 130 000 m^3 and will cover an area of approximately 4.9 ha. It will function as a "pump-to" facility and will receive water as removed from the opencast pit, underground operation, and other facilities where capacity is required. PCD 2 will also receive affected runoff from a small portion of the sub-catchment reporting to PCD 3 (i.e., S1). Hence, once PCD 2 is operational, the size of the sub-catchment reporting to PCD 3 (i.e., S1) will be reduced. PCD 1 Compartment 4B **(5)** is a proposed new facility that will be constructed north-west of the existing SWCD. PCD 4 will receive water as removed from the opencast pit and the VUP, from where it can be fed into the Venetia Mine water reticulation system. According to the report *Venetia Stormwater Management Project - conceptual evaluation of polluted water storage options,* dated 28 September 2020 and prepared by Jones and Wagner, this facility should have a storage capacity of 34 000 m^3 and will cover an area of approximately 1.8 ha. This facility is, however, optional and is not required to maintain the water balance at Venetia Mine. If constructed, PCD 1 Compartment 4B will also receive affected runoff from a small portion of the sub-catchment reporting to PCD 1 (i.e., S2). Hence, once PCD 1 compartment 4B is operation, the size of the sub-catchment reporting to PCD 1 (i.e., S2) will be reduced. FRD 1 RWD **(6)** is an existing facility located south-east of FRD 1 with a capacity of 27 500 m^3. The facility currently receives water from the FRD 1 via penstock, treated effluent from the sewage plant and a small portion of the upstream catchment adjacent to the opencast pit. It therefore jointly operates as a RWD and as a PCD, which means that the facility is mostly operated at or near full capacity and during heavy rainfall events, affected water may spill from this facility. Accordingly, FRD 1 RWD will be expanded to increase its storage capacity. Based on the results from Jones & Wagner's 2020 Water Balance, the dam walls of FRD1 RWD should be raised by 3 m to increase its capacity from 27 500 m^3 to 155 000 m^3. This will provide additional capacity for affected water

Reference number corresponding to Figure 8	Current & proposed strategies
 	from FRD 1 and provide enough storage capacity to limit spillages to less than 2% (i.e., less than 1 in 50 years on average) in accordance with Regulation GN 704. OMWDS-N&S **(7)** are existing facilities located south of the SWCD with a capacity of 460 000 m^3. OMWSD-N&S receive water from the opencast pits, the plant and the Well Fields (it will also receive water from the VUP in the future). Based on Jones & Wagner's 2020 Water Balance, the combined storage capacity of these facilities should be increased from 460 000 m^3 to 555 000 m^3 by raising the dam walls with 2 m. This will provide the required additional storage capacity and it will limit spills to less than 2% (i.e., less than 1 in 50 years on average) in accordance with Regulation GN 704. OMWSD-3 **(8)** is a proposed additional facility that will be constructed north of OMWSD-N&S and south of the proposed PCD 1. It will receive water from the opencast pits, the plant, the underground mine and the Well Fields. Based on the water balance, OMWSD-3 will provide an additional storage capacity of 239 000 m^3 and will cover an area of approximately 8.1 ha. OMWSD -4 **(9)** is a proposed additional facility that will be constructed adjacent to OMWSD-N&S within the current low lying storm water detention dam. It will contain water from the opencast pits, the plant, the underground mine and the Well Fields. Based on the water balance, OMWSD-4 should be designed to provide an additional storage capacity of 192 000 m^3 and it will cover an area of approximately 5.2 ha. The storm water detention dam (also referred to as the attenuation facility) receives runoff from a large upstream catchment and was constructed to achieve flood peak attenuation during heavy rainfall events in order to reduce peak flow entering the river diversion. A study was undertaken to determine how the proposed OMWSD-4 will affect the functionality of the storm water detention dam, titled *De Beers- Venetia Stormwater Management Plan: Effect of Proposed OMWSD-4 on River Diversion and Flood Risk,* dated October 2020 and prepared by Jones & Wagner. The study concluded that the proposed facility would have a minimal, negligible impact on the storm water diversion's flood attenuation functionality, with the diversion expected to still function effectively with the proposed OMWSD-4, for both the 1:200 year and 1:1000 year events that were evaluated.

Reference number corresponding to Figure 8	Current & proposed strategies
	**<u>Temporary storage of affected water in K03 Pit (10)</u>** The K03 Pit is located to the east of FRD 2 on the north-western perimeter of the open pit with a total in-pit storage capacity of 3.5 Mm^3. <u>Problem statement:</u> There is a safety berm surrounding the pit perimeter that restricts surface runoff from entering the pit in an uncontrolled manner. The pits do, however, receive direct rainfall as well as runoff from a portion of the WRDs (S4). This volume of water, together with any seepage water flowing to the K02 and K01 Pits, pose a risk to the safety of workers in the VUP. In order to de-risk the VUP, all water reporting to the underground mine will have to be contained. <u>Recommended action:</u> In order to de-risk the underground operations, it is proposed that all affected water reporting to the K02 and K01 Pits be pumped to the K03 Pit. Affected water will then be temporarily stored in the K03 Pit , to alleviate the storage capacity required on the surface (especially during heavy rainfall periods), whereafter it will be pumped to the OMWSDs for re-used within the plant. It is also proposed to redirect some of the runoff from the waste rock dumps that currently flows into the K01 and K02 Pits (which are going to be undermined as part of the VUP) to the K03 Pit.
 	**<u>Mine Water discharge (11)</u>** <u>Problem Statement</u> Water will accumulate in the open pits and the unground workings of the VUP from surface runoff, direct rainfall and underground seepage. If there is not sufficient capacity available to contain this water, it may pose a risk to the safety of workers in the VUP. <u>Recommended Action</u> Venetia Mine proposes to discharge surplus water into the receiving environment from PCD 3 and / or OMWSD-N&S, not only as a means of managing surplus water but also to ensure safety in the underground workings of the VUP. PCD 3 will discharge via a spillway located at the north-western corner and OMWSD-N&S will discharge into the river diversion via the spillway. The discharge of affected water will only be conducted should PCD 3 or OMWSD-N&S have insufficient capacity and in accordance with the relevant environmental authorisations.

6 Risk Assessment / Best Practice Assessment

6.1 Risk Assessment Procedure

The environmental risk of any aspect is determined by a combination of parameters associated with the impact. Each parameter connects the physical characteristics of an impact to a quantifiable value to rate the environmental risk.

Impact assessments should be conducted based on a methodology that includes the following:

- Clear processes for impact identification, prediction and evaluation,
- Specification of the impact identification techniques,
- Criteria to evaluate the significance of impacts,
- Design of mitigation measures to lessen impacts,
- Definition of the different types of impacts (indirect, direct or cumulative), and
- Specification of uncertainties.

After all impacts have been identified, the nature of each impact can be predicted. The impact prediction will take into account physical, biological, socio-economic and cultural information and will then estimate the likely parameters and characteristics of the impacts. The impact prediction will aim to provide a basis from which the significance of each impact can be determined and appropriate mitigation measures can be developed.

The risk assessment methodology is based on defining and understanding the three basic components of the risk, i.e. the source of the risk, the pathway and the target that experiences the risk (receptor). Refer to Figure 9 below for a model representing the above principle (as contained in the DWS's Best Practice Guideline: *G4 – Impact Prediction*).

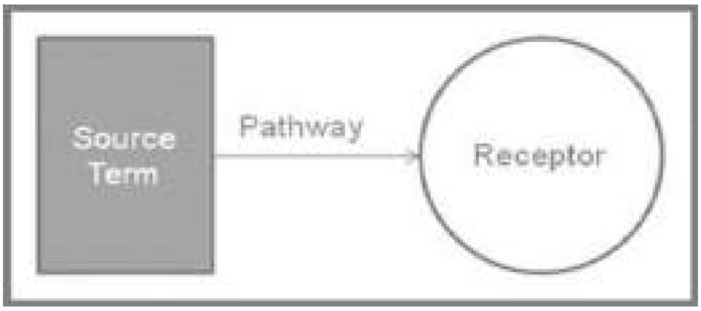


Figure 9: DWS's model for impact prediction (risk assessment).

Table 4 and Table 6 below indicate the methodology to be used in order to assess the Probability and Magnitude of the impact, respectively, and Table 5 provides the Risk Matrix that will be used to plot the Probability against the Magnitude in order to determine the Severity of the impact.

Table 4: Determination of Probability of Impact.

SCORE	FREQUENCY OF ASPECT / UNWANTED EVENT	AVAILABILITY OF PATHWAY FROM THE SOURCE TO THE RECEPTOR	AVAILABILITY OF RECEPTOR
1	Never known to have happened, but may happen	A pathway to allow for the impact to occur is never available	The receptor is never available
2	Known to happen in industry	A pathway to allow for the impact to occur is almost never available	The receptor is almost never available
3	< once a year	A pathway to allow for the impact to occur is sometimes available	The receptor is sometimes available
4	Once per year to up to once per month	A pathway to allow for the impact to occur is almost always available	The receptor is almost always available
5	Once a month - Continuous	A pathway to allow for the impact to occur is always available	The receptor is always available

Step 1: *Determine the* ***PROBABILITY*** *of the impact by calculating the average between the Frequency of the Aspect, the Availability of a pathway to the receptor and the availability of the receptor.*

Table 5: Determination of severity of the impact.

ENVIRONMENTAL IMPACT RATING / PRIORITY					
	MAGNITUDE				
PROBABILITY	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Low	Medium	High	High	High
4 Likely	Low	Medium	High	High	High
3 Possible	Low	Medium	Medium	High	High
2 Unlikely	Low	Low	Medium	Medium	High
1 Rare	Low	Low	Low	Medium	Medium

Step 3: *Determine the* ***SEVERITY*** *of the impact by plotting the averages that were obtained above for Probability and Magnitude in the table below.*

Table 6: Environmental impact assessment

Score	SOURCE				RECEPTOR	
	Duration of impact	**Extent**	**Volume / Quantity / Intensity**	**Toxicity / Destruction Effect**	**Reversibility**	**Sensitivity of environmental component**
1	Lasting days to a month	Effect limited to the site. (metres);	Very small quantities / volumes / intensity (e.g. < 50 ℓ or < 1 ha)	Non-toxic (e.g. water) / Very low potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes will remain unaltered.	Current environmental component(s) are largely disturbed from the natural state. Receptor of low significance / sensitivity
2	Lasting 1 month to 1 year	Effect limited to the activity and its immediate surroundings. (tens of metres)	Small quantities / volumes / intensity (e.g. 50 ℓ to 210 ℓ or 1 ha to 5 ha)	Slightly toxic / Harmful (e.g. diluted brine) / Low potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes might be negligibly altered or enhanced / Still reversible	Current environmental component(s) are moderately disturbed from the natural state. No environmentally sensitive components.
3	Lasting 1 – 5 years	Impacts on extended area beyond site boundary (hundreds of metres)	Moderate quantities / volumes / intensity (e.g. > 210 ℓ < 5000 ℓ or 5 – 8 ha)	Moderately toxic (e.g. slimes) Potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes might be notably altered or enhanced / Partially reversible	Current environmental component(s) are a mix of disturbed and undisturbed areas. Area with some environmental sensitivity (scarce / valuable environment etc.).
4	Lasting 5 years to Life of Organisation	Impact on local scale / adjacent sites (km's)	Very large quantities / volumes / intensity (e.g. 5000 ℓ – 10 000 ℓ or 8 ha– 12 ha)	Toxic (e.g. diesel & Sodium Hydroxide)	Bio-physical and/or social functions and/or processes might be considerably altered or enhanced / potentially irreversible	Current environmental component(s) are in a natural state. Environmentally sensitive environment / receptor (endangered species / habitats etc.).
5	Beyond life of Organisation / Permanent impacts	Extends widely (nationally or globally)	Very large quantities / volumes / intensity (e.g. > 10 000 ℓ or > 12 ha)	Highly toxic (e.g. arsenic or TCE)	Bio-physical and/or social functions and/or processes might be severely/substantially altered or enhanced / Irreversible	Current environmental component(s) are in a pristine natural state. Highly Sensitive area (endangered species, protected habitats etc.)

Step 2: *Determine the* ***MAGNITUDE*** *of the impact by calculating the average of the factors above.*

6.2 Venetia Mine – Risk Assessment

The aim of this section is to provide information regarding the potential environmental impacts on the surface water resources associated with the Project. The impact on the surface water resources can be divided into two main categories namely, impact on surface water quality and impact on surface water quantity. In order to provide background information and a framework for the environmental risk assessment, the major impacts on the surface water resource are provided below.

Table 7: Risks associated with the construction / expansion phase of the proposed facilities.

No.	Aspects Affected	ACTIVITY Whether listed or not listed	POTENTIAL IMPACT	SIGNIFICANCE If not mitigated			MITIGATION MEASURES	SIGNIFICANCE If mitigated		
			Impact description	Probability	Magnitude	Significance		Probability	Magnitude	Significance
1	Surface Water	Grading, vegetation clearing and soil stripping	As part of the construction phase of the Project, several additional water storage facilities will be constructed (including PCD 1, PCD 2, PCD 3, PCD 1 Compartment 4B, OMWSD-3, and OMWSD-4) and some existing facilities will be expanded (including FRD 1 RWD, and OMWSD-N&S). A network of affected water channels will also be constructed to convey surface runoff to the runoff receiving PCDs. Furthermore, the existing southern access road that runs adjacent to the south-eastern portion of the mine boundary security fence, will be upgraded and expanded to a 10 m wide road (currently 4 m wide) to provide access of construction vehicles to the proposed PCD 3 locality. Grading, vegetation clearing, and soil stripping will be carried out as part of the construction phase. There may be a decrease in surface water quality when any surface water comes into contact with dust, eroded soil, or other pollutants generated during the construction / expansion phase of the Project. The sediment load within surface water runoff may increase or the chemistry of surface water may be altered if not prevented or mitigated. The construction of PCD 3 and expansion of the southern access road will have the highest risk of contaminating surface water resources, due to its close proximity to the Kolope River and the existing river diversion. **Surface water quality** Contamination of surface water resources causes deterioration of water quality, affecting the use of surface water as a natural resource.	4	3	H	Mitigation • Disturbed areas should be limited to the footprint as depicted in the layout plan. • The laydown areas for each construction site must be kept as small as reasonably possible. • Place topsoil stockpiles in designated areas with measures in place to prevent erosion and to minimise deposition of sediment in the downstream environment. • Particular care should be taken to mitigate the impacts on surface water quality during the construction of PCD 3 and the expansion of the southern access road. Temporary containment berms may have to be constructed downstream of areas where runoff is likely to accumulate. This will allow runoff to settle as it ponds against the berms, resulting in less suspended particles and less sediment being transported downstream in the event of water overflowing from the berms during heavy rainfall events. • Where possible, construction activities should be scheduled to coincide with the dry season.	2	2	L
2	Surface Water	Use, storage, and handling of hazardous materials.	Spillages of hazardous materials (i.e., cement, oil, fuel and / or grease) used during the construction phase of the Project may impact negatively on the surrounding clean water environment. The construction of PCD 3 and expansion of the southern access road will have the highest risk of contaminating surface water resources, due to its close proximity to the Kolope River and the river diversion. **Surface water quality** Deterioration of water quality due to chemical contamination affecting the use of surface water as a natural resource.	3	3	M	Mitigation • Regular maintenance should be conducted on all vehicles and equipment used during the construction / expansion phase to ensure they are always in a good working order. • Treat all hydrocarbon spills as hazardous waste and dispose of accordingly. • Emergency spill kits should be available, and all chemical spills should be cleaned up quickly and effectively with approved absorbent material. • Ensure that all mixing practices are conducted on impermeable surfaces. • All vehicle and equipment usage should be limited to designated areas only of which access is controlled. • Store fuel, oil, and other hazardous substances in designated bunded areas able to contain 110% of the storage capacity. • Refuelling of vehicles to take place on an impermeable surface fitted with a sump to contain any spillages.	1	2	L

Table 8: Risks associated with the operational phase of the proposed facilities.

No.	**Aspects Affected**	**ACTIVITY Whether listed or not listed**	**POTENTIAL IMPACT**	**SIGNIFICANCE If not mitigated**			**MITIGATION MEASURES**	**SIGNIFICANCE If mitigated**		
			Impact description	**Probability**	**Magnitude**	**Significance**		**Probability**	**Magnitude**	**Significance**
1	Surface Water	Implementation of the project	Currently the main risk associated with surface water at Venetia Mine is the potential deterioration of surface water quality in the receiving environment resulting from affected water leaving the mine site. The implementation of the Project will reduce this risk (i.e. positive impact) as all affected water generated on site will be contained and dirty runoff will be separated from clean runoff more effectively.	Positive Impact						
2	Surface Water	Runoff receiving PCDs[2]	Runoff receiving PCDs. PCDs that will receive surface runoff directly include PCD 3, PCD 1 and the SWCD. PCD 3 will be constructed directly west of the CRD with a capacity of 1 050 000 m^3. It will receive runoff from S1, seepage from the FRDs and water from the underground operations (via the K03 Pit). PCD 1 will be constructed south of the existing SWCD with a capacity of102 000 m^3. It will only receive water in the form of surface runoff from S2. The SWCD is an existing PCD located directly south of the open pit with a capacity of 27 500 m^3. The SWCD will receive runoff from S3 and from the underground operations (via the K03 Pit). Once the runoff receiving PCDs are operational, there are two main potential impacts on surface water quality and quantity. Firstly, there will be a reduction in surface water quantity of the larger catchment, as runoff and precipitation are contained in the runoff receiving PCDs mentioned above. It should be noted that this impact is a continuation of an existing impact due to the existing mining activities at Venetia Mine. The area applicable to the Project is already considered a dirty water area and runoff reporting to S2 and S3 is already being collected and contained in the SWCD. Runoff generated in S1 is currently not being collected and contained and will exacerbate the magnitude of this existing impact (i.e., more runoff will be contained). Secondly, there may be a reduction in surface water quality of the downstream environment in the event of spillages from the facilities. The risk of spillages, based on Jones & Wagner's 2020 water balance, is, however, less than 2% (i.e., less than 1 in 50 years on average), in accordance with Regulation GN 704. **Surface water quality and quantity** • There may be a deterioration of surface water quality due to chemical contamination resulting from spillages, affecting the use of surface water as a natural resource. • There will be a reduction in the quantity of water reporting to the larger quaternary catchment (A63E) as runoff from S1, S2 and S3 is contained in the PCDs.	4	2	M	Mitigation • The runoff receiving PCDs should at all times be operated below the 0.8 m freeboard requirement as per Regulation GN 704. • The associated affected water channels should be sloped / excavated that the lowest points are located at the PCD inlets to ensure all runoff is conveyed to the PCDs effectively via gravity. • The affected water channels should be suitably lined (i.e., cement) in order to prevent erosion and should be designed to contain the 1:50-year 24-hour flood without spillages. • The twin compartment silt traps located at each PCD inlet should be operated in an alternating fashion to allow efficient servicing of the compartments. • Silt accumulation and vegetation growth within the PCDs and silt traps must be regularly cleaned / removed to unsure optimal capacity is always available. • Pumping infrastructure will be essential to maintain the water balance at Venetia Mine and should undergo regular maintenance to ensure they are always in a good working order. • Further, it is proposed that Venetia Mine develops and implements a maintenance schedule to ensure that all components of the dirty water systems are always maintained to ensure optimal serviceability, functionality, and capacity.	2	2	L
3	Surface Water	Proposed additions and expansions to dirty water containment facilities	Dirty water containment facilities. The additional dirty water containment facilities include the construction of PCD 2, PCD 1 Compartment 4B, OMWSD-3, and OMWSD-4, and the expansion of FRD 1 RWD and OMWSD-N&S. These facilities will mainly function as "pump-to" facilities , where affected water can be pumped to or from, depending on the situational requirements. PCD 2, PCD 1 Compartment 4B and FRD 1 RWD will also receive some affected runoff which will subsequently reduce the size of the sub-catchment reporting to PCD 3 and PCD 1.	2	3	M	Mitigation • The dirty water containment facilities should at all times be operated below the 0.8 m freeboard requirement as per Regulation GN 704. • Pumping infrastructure will be essential to the operation of these facilities and for maintaining the water balance. The infrastructure should undergo regular maintenance to ensure they are always in a good working order.	1	2	L

[2] Runoff receiving PCDs refer to the containment facilities that will be constructed initially to collect and contain affected runoff generated on-site (i.e., PCD 3, and PCD 1) as well as the existing SWCD that currently receives affected runoff.

No.	Aspects Affected	ACTIVITY Whether listed or not listed	POTENTIAL IMPACT Impact description	SIGNIFICANCE If not mitigated Probability	Magnitude	Significance	MITIGATION MEASURES	SIGNIFICANCE If mitigated Probability	Magnitude	Significance
			PCD 2 will be constructed to the north-west of the plant area with a storage capacity of 130 000 m^3. PCD 1 Compartment 4B will be constructed north-west of the existing SWCD with a storage capacity of 34 000 m^3. OMWSD-3 will be constructed north of OMWSD-N&S with a storage capacity of 239 000 m^3. OMWSD-4 will be constructed adjacent to OMWSD-N&S within the current low lying storm water detention pond with a capacity of 192 000 m^3. FRD 1 RWD is an existing facility located south-east of FRD 1 and its capacity will be increased from 27 500 m^3 to 155 000 m^3. OMWSD-N&S are existing facilities located south of the SWCD and its capacity will be increased from 460 000 m^3 to 555 000 m^3. The main surface water related risk associated with the above-mentioned facilities is a deterioration of surface water quality due to spillages. The risk of spillages, based on Jones & Wagner's 2020 water balance, is however less than 2% (i.e., less than 1 in 50 years on average), in accordance with Regulation GN 704. Based on the proposed location of PCD 1, PCD 2, PCD 1 Compartment 4B and OMWSD-3, spillages are likely to drain back into the surrounding affected water channels and will be contained in one of the runoff receiving PCDs, reducing the impact of spillages from these facilities. Spillages from OMWSD-N&S and OMWSD-4 are, however, likely to drain into the existing river diversion and then into the Kolope River, therefore having a higher impact on water quality. **Surface water quality** • There will be a deterioration of surface water quality due to chemical contamination resulting from spillages, affecting the use of surface water as a natural resource.				• Silt accumulation and vegetation growth within the dams must be regularly cleaned / removed to unsure optimal capacity is always available. • Further, all dirty water containment facilities and associated infrastructure should be included in the maintenance schedule recommended above.			
4	Surface Water	K03 Pit	The K03 Pit is located to the east of FRD2 on the north-western perimeter of the open pit with a total in-pit storage capacity of 3.5 Mm^3. The safety berm surrounding the pit perimeter restricts surface runoff from entering the pit in an uncontrolled manner. The pits do, however, receive direct rainfall as well as runoff from a portion of the WRDs. This volume of water, together with any seepage water flowing to the K02 and K01 Pits, pose a risk to the safety of workers in the VUP. In order to de-risk the underground operations, it is proposed that all water reporting to the K02 and K01 Pits and the VUP be pumped to the K03 Pit temporarily whereafter it will be pumped to the OMWSDs for re-used within the plant. Due to the sheer volume of the K03 Pit, spillages are highly unlikely and, therefore, the impact on surface water quality is negligible. In terms of surface water quantity, there will be a continuation of the current impact (i.e., runoff and rain entering the pit) leading to a reduction in the amount of runoff reporting to the larger catchment. There is no new surface water related impacts associated with the storage of water in the K03 Pit.	2	2	L	Mitigation • Pumping infrastructure will be essential to the operation of the K03 Pit and to ensure the safety of people working in the VUP. It is imperative that all pumping infrastructure undergo regular maintenance to ensure they are always in a good working order. • It is recommended that Venetia Mine apply for exemption to Regulation 4(c) of GN 704 and to license the pit as a dirty water containment facility in terms of Section 21 (g) of the National Water Act (Act No. 36 of 1998).	2	2	L
5	Surface Water	Southern Access Road	The southern access road is an existing gravel road and will be upgraded and expanded to a 10 m wide road (currently 4 m wide) to provide access of construction vehicles to the proposed PCD 3 locality. There are two main surface water related problems associated with the southern access road. Firstly, the road may impact on the natural drainage of surface water in the surrounding area as it is assumed that the access road will be slightly elevated. If left unmitigated, surface runoff may pond against the road that could lead to a reduction in the volume of runoff (i.e., quantity) reporting to the downstream catchment. Secondly, the surface area of the road will be compacted, creating an impermeable area where runoff cannot infiltrate into the ground. This may increase the volume and velocity of runoff along the road,	3	2	M	Mitigation: • It is recommended that the southern access road be designed and managed in such a manner as to disperse runoff and to prevent the concentration of storm water flow. • The access road should be designed to ensure effective drainage of surface runoff reporting to the receiving environment.	2	1	

No.	Aspects Affected	ACTIVITY Whether listed or not listed	POTENTIAL IMPACT Impact description	SIGNIFICANCE If not mitigated: Probability	Magnitude	Significance	MITIGATION MEASURES	SIGNIFICANCE If mitigated: Probability	Magnitude	Significance
			resulting in higher erosion rates, particularly at points where the flow of water is concentrated. Increased erosion rates may increase the sediment load in the runoff resulting in a reduction is surface water quality downstream. **Surface water quantity and quality** • Deterioration of surface water quality due to increased erosion and sedimentation. • There will be a decrease in clean water runoff reporting to the downstream catchment if runoff is left to pond against the road, potentially reducing the availability of water to downstream users.				• Erosion prevention measures (e.g., cement, rock or gabions) should be installed at flow concentration points to dissipate runoff and decrease erosion rates. • Finally, Venetia Mine should conduct regular inspections and implement a maintenance schedule to ensure the integrity and functionality of all storm water management measures and controls are maintained.			
6	Surface Water	Mine Water discharge	Venetia Mine proposes to discharge surplus water from PCD 3 and OMWSD-N&S into the receiving environment, not only as a means of managing surplus water but also to ensure safety in the underground workings of the VUP. The discharge of affected water will only be conducted should PCD 3 or OMWSD-N&S have insufficient capacity and in accordance with the relevant approvals (Environmental Authorisation and Water Use Licence). The impact of this activity on surface water quality will be assessed as part of the aquatic biodiversity impact assessment The outcome of this impact assessment will be included upon finalisation of this report.	To be determined by aquatic specialist and included at finalisation of this report.			• Mitigation measures to be proposed by aquatic specialist.	To be determined by aquatic specialist and included at finalisation of this report.		

7 General storm water management measures

Efficiency and practicality are key aspects to a successful storm water management plan. Good management is based on managing the expected runoff volumes and separating clean and dirty water that, therefore, incorporates the fundamental principle of pollution prevention. All proposed measures should prioritise the use of gravity and natural drainage lines to provide cost-effective solutions with minimum maintenance requirements. The following general storm water management measures are proposed as part of this SWA:

- The capacity of all storm water conveyance structures and containment facilities should accommodate at least a 1:50-year flood event, or as determined by the Jones and Wagener Water Balance.
- Where possible, PCDs should be operated with minimum energy consumption by utilising gravity transfer and siphons.
- All channels, trenches, containment facilities, spillways and sumps should be inspected and serviced regularly to ensure design capacity and integrity are maintained. Storm water control measures should be kept clear of obstructions by objects as well as siltation, especially where the velocity of the runoff is induced.
- Affected runoff should be controlled, management and used in order to meet Venetia Mine's objectives in terms of water reuse and recycling.
- No affected water from Venetia Mine, other than from the proposed discharge locations (and in accordance with the relevant authorisations), is allowed to spill into the clean water environment. This should be ensured through operational control measures.
- Siltation of storm water containment and conveyance infrastructure will be a continual challenge at Venetia Mine. Therefore, it is important to design these structures for easy maintenance and servicing. Silt build-up within conveyance and containment facilities, i.e., dirty water channels, sumps, the proposed PCDs, the OMWSDs, and the RWDs should be monitored and regularly removed to ensure sufficient storage capacity.
- Sediments should be contained as far as possible surrounding the MRDs in order to reduce the sediment load reporting to the PCD sediment traps.
- Some sections of the storm water canals could have low gradients due to the topography, causing low flow velocities with resultant increased sedimentation. These sections will need ongoing maintenance to ensure functionality.
- Seepage controls to intercept and handle any shallow contaminated seepage arising from the MRDs should be implemented and affected water should be routed to the PCDs.
- Pumping of storm water to storage facilities or to the plant system will be critical to manage the overall mine water balance and must be given preference to make up water from the raw water supply. The pumping infrastructure will be essential in order to rapidly pump water to or from the dirty water containment facilities, depending on the situational requirements.

- Erosion prevention measures (e.g. grass, cement, rock or gabions) should be in place at all water flow concentration points. These areas include roads, channels, channel outlets, discharge points and other infrastructure that may increase surface runoff.
- The size of un-rehabilitated areas that produce contaminated runoff should be minimised. Rehabilitation should be planned to promote free drainage and to minimise or eliminate ponding of storm water.
- Measures should be in place to minimise the intake of clean water from the wellfields. The following mitigation measures serves as a guideline to optimise water use:
    - Reuse and recycling of affected mine water should be prioritised in order to offset the intake of uncontaminated raw water from the wellfields;
    - Regular maintenance and inspection of equipment to prevent leaks;
    - Regular site inspections by supervisors to prevent wastage of water;
    - Environmental training and awareness of staff; and
    - Monitoring of resource consumption (site specific).

8 Conclusion

Shangoni was appointed by Venetia Mine to conduct a SWA for the Project. The proposed storm water management measures to separate clean and dirty water and to contain affected runoff and seepage on site were discussed as part of this SWA. The assessment was compiled using all relevant available information and data for the site to define the surface water regime and to highlight current and foreseeable risks towards the receiving surface water environment (in terms of surface water quality and quantity). This specialist SWA was undertaken to fulfil in the requirements of a Water Use Licence Application (WULA) and Environmental Impact Assessment (EIA).

The specialist SWA relating to this application concluded and recommended the following:

- It can be concluded that the Project will have an overall positive impact on surface water quality, as Venetia Mine currently has inadequate capacity to contain all affected water generated on site. After the construction of the proposed facilities and the associated infrastructure, all affected water generated on site will be contained in PCD facilities designed to limit spillages to less than 2% (i.e., less than 1 in 50 years on average), as required by Regulation GN 704.
- Potential negative impacts on surface water quality and quantity, include spillages from the PCD facilities; discharge of affected water to the receiving environment (the quantitative impact of discharging is pending the outcome from the aquatic biodiversity impact assessment); and temporary contamination of surface water resources resulting from the construction phase.
- There will be no additional impacts on surface water quantity, apart from a continuation of the exiting impact (i.e., a reduction in the amount of surface water reporting to the larger catchment due to runoff and precipitation being contained in the existing and proposed PCDs and in the open pits).
- Discharge of affected water into the natural surface water environment should only be conducted should PCD 3 or OMWSD-N&S have insufficient capacity and in accordance with the relevant authorisations (Environmental Authorisation and Water Use Licence).

- It is recommended that the proposed infrastructure designs and maintenance requirements be integrated into the existing operational management measures.
- It is the responsibility of Venetia Mine to ensure that the proposed facilities and associated infrastructure be constructed to be capable of withstanding, as a minimum, the expected 1:50-year flood event reporting to the proposed containment facilities and conveyance infrastructure, as per Regulation GN 704.
- It should be taken into consideration that the potential for erosion increases where surface runoff is concentrated and must be addressed through implementing the mitigation measures detailed in this report. Storm water management measures detailed in this report should be prioritised to prevent damage or failures during flood events.
- If the mitigation measures proposed as part of this SWA are followed, no substantial negative surface water related impacts, quality and / or quantity, are foreseen during construction, operation or post-closure phases.

These conclusions and recommendations are made in accordance with the Best Practise Guidelines G1 for Storm Water Management (DWAF, 2006), the National Water Act (Act No. 36 of 1998) and Regulation GN 704 of the National Water Act (Act 36 of 1998). Based on the findings of this SWA, no fatal flaws have been identified that may limit the expansion activities. It is the opinion of the specialist that the proposed project may proceed on condition that all mitigation measures as outlined and discussed in this report are adhered to.

9 Disclaimer

This report has been produced by Shangoni Management Services (Pty) Ltd., ("Shangoni") with the skill and care ordinarily exercised by a reasonable Environmental Consultant at the time the services were performed. Further, and in particular, the Services were performed by Shangoni taking into account the limits of the scope of works required by the Client, the time scale involved and the resources, including financial and manpower resources. None of the work performed during this project shall constitute or be represented as a legal opinion of any kind or nature but shall be a representation of the findings.

No warranties or guarantees, expressed or implied, are included in or intended by the report, except that it has been prepared in accordance with the current generally accepted practices and standards consistent with the level of care and skill exercised under similar circumstances by professional consultants or firms that perform the same or similar services. Any reference to legislation in this report should not be perceived as a substitute for the provisions of such legislation. In the event of any inconsistency between this document and such legislation, the latter would prevail.

Whilst every endeavour has been made by the Shangoni to ensure that information provided is correct and relevant, this report is, of necessity, based on information that could reasonably have been sourced within the time period allocated to the assessment, and is, furthermore, of necessity, dependent on information provided by management and/or its representatives. It should, accordingly, not be assumed that all possible and applicable findings, observations and/or measures are included in this report as this report represents a sample of assessable parameters. As a subsequent event, should additional information become available, Shangoni reserves the right to amend its findings, observations, measures and executive summary.

10 Specialist declaration

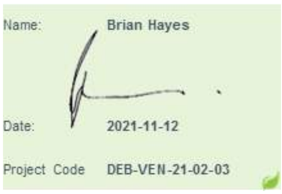
I, Francois H. Schutte declare that:

General declaration:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority; and – the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.

Signature of the Specialist, (MSc)

Date: 12 November 2021



Signature of technical reviewer, Pr Eng.

Date: 12 November 2021