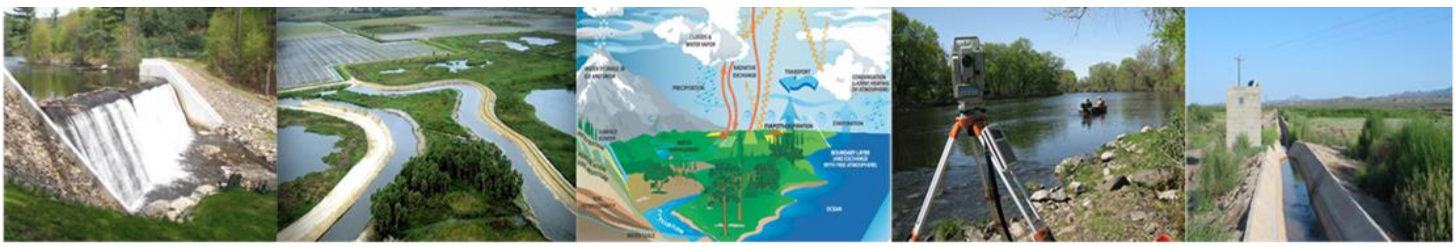
Storm Water Management Plan for Klipspruit Colliery: Pit BD and Pit H Underground Expansion Project

Report

Version – 3rd Draft

20 January 2026

Client Reference: Klipspruit Colliery – Pit BD and Pit H SWMP



Storm Water Management Plan for Klipspruit Colliery

REPORT

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SPECIALIST DETAILS AND DECLARATION

Specialist Details

Sbongiseni Mazibuko is a hydrologist focusing specifically on hydrological perspectives of land use management and climate change. Sbongiseni has – over the past nine years – worked on numerous projects for a variety of clients ranging from mining, agriculture, and public entities, which included hydrological assessments, water balances, stormwater planning and management, floodlines modelling, catchment yield assessments and water conservation and water demand management plans.

Declaration

This report has been prepared in accordance with Section 13: General Requirements for Environmental Assessment Practitioners (EAPs) and Specialists, as well as per Appendix 6 of GNR 982 – Environmental Impact Assessment Regulations and the National Environmental Management Act (NEMA No. 107 of 1998 as amended 2017) and Government Notice 704 (GN 704). It has been prepared independently of influence or prejudice by any parties.

I, *Sbongiseni Christian Mazibuko*, declare that –

- I act as the independent specialist in this application,
- I regard the information and data contained in this report to be accurate and correct as per the provision of data from the client,
- I do not have any vested interest (i.e., business, financial, personal, or other) in the project other than remuneration for the professional work performed, and
- I conducted the work relating to the project objectively in line with my profession and regulatory body and within the confines of the applicable legislation.

Mr. Sbongiseni Christian Mazibuko

MSc Hydrology, (*Pr.Sci.Nat.* reg number: 011204)

LIST OF ACRONYMS

BPG	Best Practice Guidelines
CN	Curve Number
DRE	Design Rainfall Estimation
DEM	Digital Elevation Model
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Program/Plan
GN	Government Notices
IWULA	Integrated Water Use Licence Application
KPS	Klipspruit Colliery
KPSX	Klipspruit Extension Weltevreden
KPSS	Klipspruit South
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
Mamsl	Meters Above Mean Sea Level
Mcm	Million Cubic Meters
MTPA	Million Tonnes Per Annum
MPRDA	Mineral and Petroleum Resources Development
NEM: WA	National Environment Management Act: Waste Management Act
NEMA	National Environmental Management Act
NWA	National Water Act
NWRS	National Water Resource Strategy
PCD	Pollution Control Dam
SCS	Soil Conservation Services
SAWS	South African Weather Station
SWMP	Storm Water Management Plan
WMA	Water Management Area

CONTENTS PAGE

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Klipspruit Colliery, owned by Seriti Power (Pty) Ltd (hereafter Seriti Power), is a coal mine located approximately 5 km from Ogies and the Phola Township in Mpumalanga, South Africa (Figure 1-1). The mine supplies coal to Eskom, approximately 2.4 million tonnes per annum (Mtpa), 0.35 Mtpa for the domestic market, and around 5.1 Mtpa of bituminous thermal coal for the export market.

Seriti Power, with its Klipspruit Colliery (KPS), operates three mining areas under the Department of Mineral Resources and Energy (DMRE) single Mining Right (Ref No. MP 30/5/1/2/2/125 MR). These mining areas are referred to as:

- Klipspruit Colliery (KPS) - Main Pit, Smaldeel and Bankfontein Pits;
- Klipspruit Extension Weltevreden (KPSX) - Pit BD, Pit H, Pit G, Pits, and
- Klipspruit South (KPSS) - South Pit.

The transitioning of mining Seam 2 and 4 (Pit BD shown in Figure 1-2) from opencast to underground methods, as well as the proposed underground mining at Pit H (Figure 1-3) – through the S102 amendment process – has necessitated the introduction (Pit BD) and conceptualisation (Pit H) of stormwater control measures to comply with Regulation 704 of the South African National Water Act (Act 36 of 1998). Effective stormwater management is essential during this transition to avoid environmental contamination, erosion, and flooding risks. While underground mining minimises surface disruption, it brings its own set of challenges, including the need to control water infiltration into underground operations.

Niara Environmental Consultants (Pty) Ltd (Niara) appointed Altra Watech (Pty) Ltd to update the Storm Water Management Plan (SWMP) for Pit BD and Pit H. As part of best practice in the mining sector, stormwater management must ensure that mining activities on the mine site do not negatively impact surrounding water resources and the environment. The SWMP must therefore be integrated into the planning process to enable informed decisions on mining implementation, operations, and post-mining closure. Thus, this SWMP study is required to support an Integrated Water Use Licence Application (IWULA) process in terms of the South African National Water Act, 1998 (Act No. 36 of 1998) (NWA, 1998).

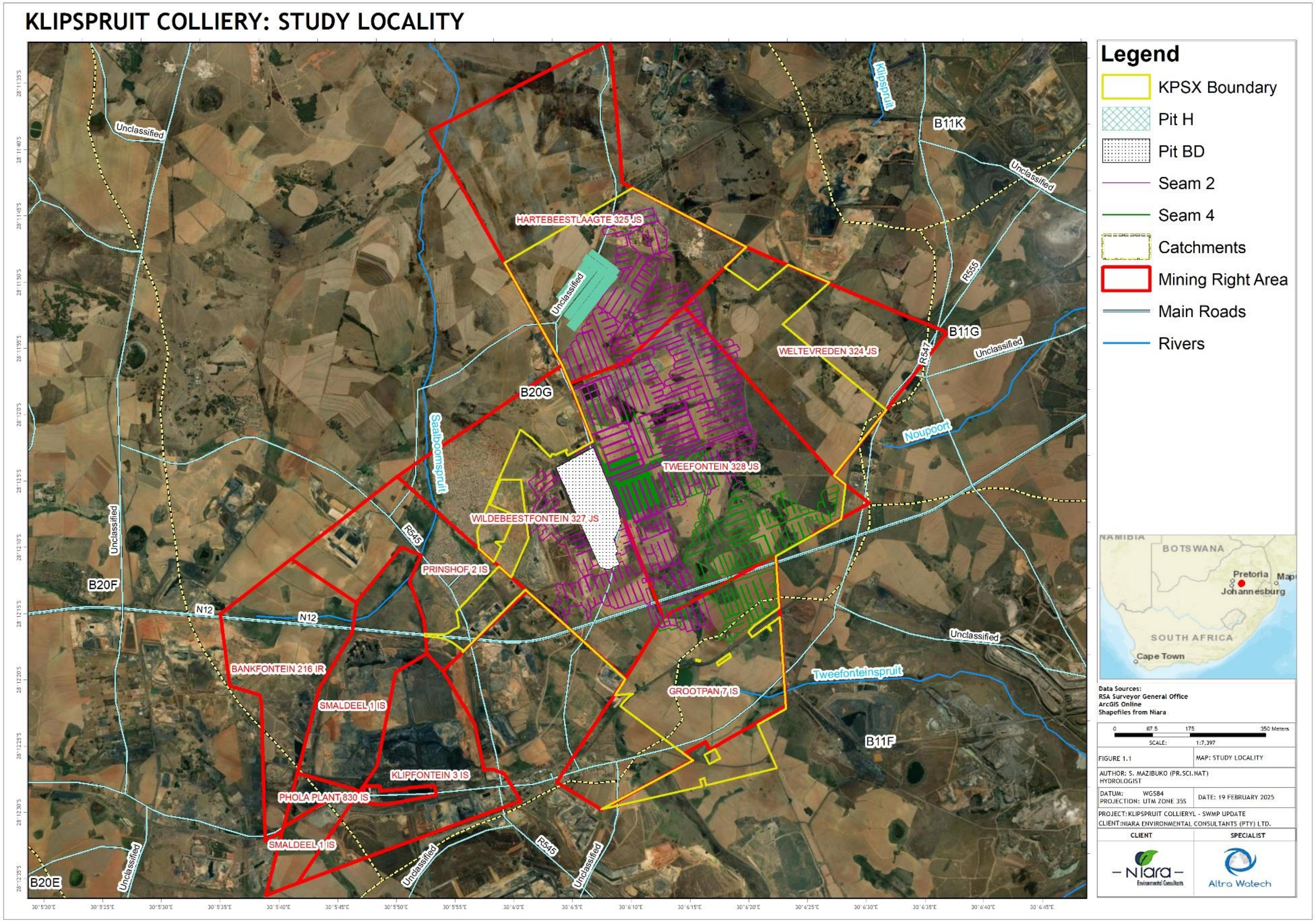

Figure 1-1: Study Locality

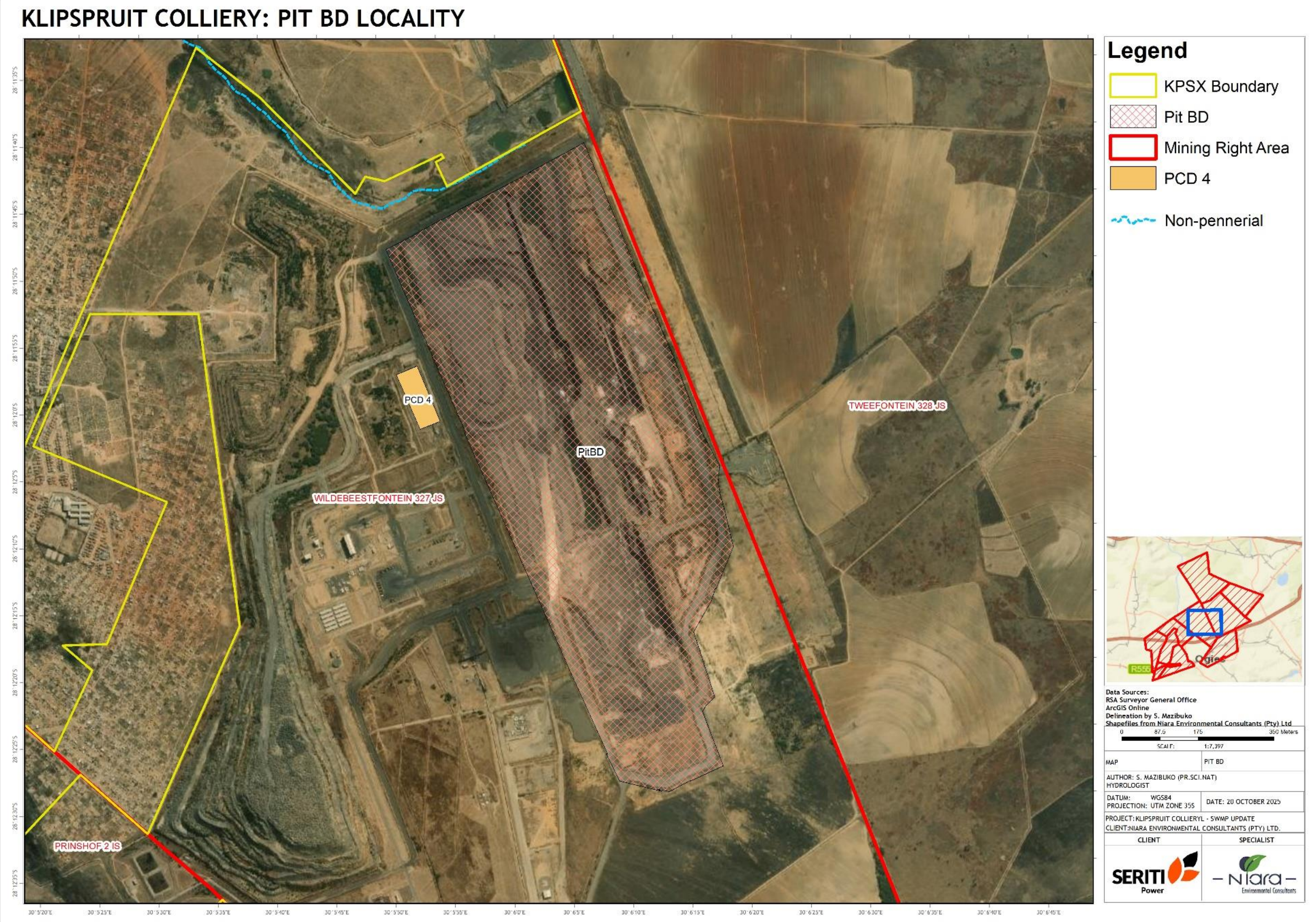

Figure 1-2: Pit BD and associated infrastructure

Figure 1-3: Pit H locality

2 LEGISLATIVE AND POLICY FRAMEWORKS

2.1 National Legislation Applicable to Hydrological Management

- Constitution of the Republic of South Africa, 1996 (No. 108 of 1996) – The Bill of Rights states that everyone has the right to an environment that is not harmful to their health or well-being;
- National Environmental Management Act, Act 107 of 1998 (NEMA) – This Act sets out the duty of care principle (Sections 28 (1) and (3) of NEMA), which is applicable to all types of pollution and must be taken into account in considering any aspects of potential environmental degradation. Every person who causes has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment. The listed activities in terms of NEMA Government Notices (GN) numbers GN R982, R983, R984 and R985, December 2014, are of relevance to the Environmental Impact Assessment (EIA) and Environmental Management Program/Plan (EMP) Amendment process;
- The National Water Act (Act No. 36 of 1998):
  - Section 19 of the National Water Act (Act No. 36 of 1998) (NWA) sets out the principles for “an owner of the land, a person in control of the land or a person who occupies or uses land” to:
    - Cease, modify or control any act or process causing pollution;
    - Comply with any prescribed waste standard or management practice;
    - Contain or prevent the movement of pollutants;
    - Eliminate any source of pollution;
    - Remedy the effects of the pollution; and,
    - Remedy the effects of any disturbance to the bed and banks of a watercourse.
  - It also describes the actions that can be taken by the catchment management agency to enforce the requirements of the NWA.
- Section 26 (1) of the NWA provides for the development of regulations that:

- Require the use of incoming and discharging water from a water resource to be monitored, measured and recorded;
- Regulate or prohibit any activity to protect a water resource or in-stream or riparian habitat; and,
- Prescribe the outcome or effect that must be achieved through management practices for the treatment of waste, or any class of waste, before it is discharged or deposited into or allowed to enter a water resource.

- Regulations have been promulgated (Regulation 704) and the Department of Water Affairs and Forestry (DWAF) Best Practice Guidelines (BPGs) have been developed for mining that set out the principles of effective stormwater management (DWAF, 2007) in the mine sites as follows:
  - Keep clean water clean;
  - Collect and contain dirty water;
  - Sustainability over the life cycle; and,
  - Consider regulations and stakeholders.
- The use of a catchment-based approach, appropriate technical studies, consideration of options, creation of performance indicators and effective training as part of a management plan is indicated.
- Regulation 704 Section 26 (1) of the NWA provides for the development of regulations that:
  - Require that the use of incoming and discharging water from a water resource be monitored, measured and recorded;
  - Regulate or prohibit any activity to protect a water resource or in-stream or riparian habitat; and,
  - Prescribe the outcome or effect that must be achieved through management practices for the treatment of waste, or any class of waste, before it is discharged or deposited into or allowed to enter a water resource.
- Regulation 704 (GNR 704) (Government Gazette 20118, 4 June 1999) was drawn up to address these issues in relation to mining activities. The principal conditions are:

- Condition 4 describes the location of infrastructure and mining activities. Any residue deposit, dam, or reservoir, together with any associated structure, must not be located within the 1:100-year floodline or within 100 m of any watercourse;
- Condition 5: Restriction on the use of any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road, or railway, or for any other purpose which is likely to cause pollution of a water resource;
- Condition 6 deals with the capacity requirements of clean and dirty water systems. Clean and dirty water systems must be kept separate and must be designed, constructed, maintained, and operated such that these systems do not spill into each other more than once in 50-years; and,
- Condition 7 describes the measures which must be taken to protect water resources. All dirty water or substances which cause or are likely to cause pollution of a water resource, either through natural surface flow or by seepage, must be contained.

- National Environment Management Act: Waste Management Act, Act 59 of 2008 (NEM: WA), provides for the regulation of waste and the prevention of pollution from the waste generated at a specific site. NEM:WA follows the principle that waste generation should be avoided, or if it cannot be avoided, that it is reduced, reused, recycled or recovered, and as a last resort, treated and/or safely disposed of. The waste management activities which require a Licence and those that require a Basic Assessment (Schedule 1 of the NEM: WA) have been reviewed. Although the Minister of Mineral Resources is the licensing authority for residue stockpiles and residue deposits, their management must be in accordance with the NEM: WA Regulations as prescribed by the Minister of Environmental Affairs (DEA). The list of Waste Management Activities that may require licensing in terms of NEM: WA has been revised as follows:
  - On 29 November 2013 (Government Notice (GN) 921, Government Gazette No 37083) and exclude treatment of effluent, wastewater or sewage;
  - On 2 May 2014 (GN332, Government Gazette No. 37604) to exclude remediation of contaminated land, now covered under Norms and Standards; and,

- On 24 July 2015 (Government Gazette GG 39020, GN: R633) to include residue stockpiles and residue deposits.

- Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA), provides for equitable access to and sustainable development of South Africa's mineral resources. The MPRDA requires that the environmental management principles set out in NEMA be applied to all mining operations and serve as a guideline for interpreting, administering, and implementing NEMA's environmental requirements.

2.2 Best Practice Guidelines

The Department of Water and Sanitation Best Practice Guideline (BPG) G1: Storm Water Management (DWAF, 2007) states the following general principles:

- Keep clean water clean:
  - Route all clean water in a natural watercourse; and,
  - Ensure that the dirty water is kept separate and that the dirty water system has a low risk of spillage.
- Collect and contain dirty water:
  - Dirty water should be diverted, collected, and contained separately from the clean water system; and,
  - Containment of dirty water should minimise the impact on clean water resources.
- Sustainability over mine life cycle; stormwater measures should be sustainable over the life of mine and different hydrological cycles; and
- On consideration and incorporation of stakeholders and regulatory agencies should be considered according to the statutory requirements.

Legislation guiding the required SWMP was adopted from the GN704 of the South African NWA, Act 36 of 1998.

2.3 National Water Resources Strategy

DWS has developed the National Water Resource Strategy (NWRS) to give effect to Section 5 of the NWA. The third edition of the NWRS (DWS, 2021) is the primary mechanism for managing water across all sectors to achieve the national government's development objectives. The water sector vision for the NWRS is "Sustainable, equitable and secure water for a better life and environment for all" and is aligned with the vision of South Africa 2030. Towards achieving this vision, the overall goal is: "Water is efficiently and effectively managed for equitable and sustainable growth and development". The NWRS2 strives to achieve three main objectives (DWA, 2021):

- Water supports the development and the elimination of poverty and inequality;
- Water contributes to the economy and job creation; and
- Water is protected, used, developed, conserved, managed, and controlled sustainably and equitably.

3 SCOPE OF WORK

The scope of work for the study is defined as follows:

1. Revision of background data and the first draft SWMP:
    - Update of data obtained since study completion, and
    - Legislative and policy frameworks relating to surface water resource management and WULA.
2. Baseline hydrology:
    - Calculation of the design rainfall, and
    - Delineation of sub-drainage areas (clean and dirty) and calculation of their relative peak flow volumes.
3. Conceptual Storm Water Management Plan:
    - Determination of stormwater flows and volumes for the 1:50-yr return period event for the clean and dirty water catchments,
    - Placement of berms, channels and positioning of the as required on-site in line with GN704 of the NWA and
    - Mapping of SWMP infrastructure on the mine infrastructure.
4. Reporting:
    - A summary report describing all the findings of the study.

4 BASELINE HYDROLOGY

4.1 Drainage

The mining rights area is located within quaternary catchment B20G, part of the Oliphants Water Management Area (WMA), covering a total area of 522 km^2. The land cover – within and surrounding the mine right area – consists largely of grasslands and cultivated lands, with a small portion occupied by dams and urban settlements.

The catchment is drained by the Saalboomspruit, which flows northward and eventually joins the Wilge River. Several unnamed tributaries also flow north, contributing to the Saalboomspruit River and helping to drain the catchment.

4.2 Topography

The terrain around the mine and its surrounding areas is characterised by rolling hills with numerous ridges and valleys. Contour data provided (Figure 4-1) for the mining rites area shows that the elevation of the project area gradually declines from 1 631 meters above mean sea level (mamsl) in the south to 1 478 mamsl in the north. Most of the area features gentle slopes of less than 4°, though steeper slopes ranging between 4° and 11° are found along the sides of ridges and river valleys. A prominent ridge runs in an east-west direction through the southern portion of the project area.

Figure 4-1: Site topography

4.3 Rainfall

The South African Weather Bureau Station (SAWS) 0478093 W Ogies (Pol), located at 26°06.887'S and 29°02.993'E, is the closest station to KPS with the most reliable record of daily rainfall (92% reliability) from 1920 to 2000. The average annual rainfall from 1920 to 2000 is 746 mm. The average monthly precipitation data is presented in Figure 4-2.

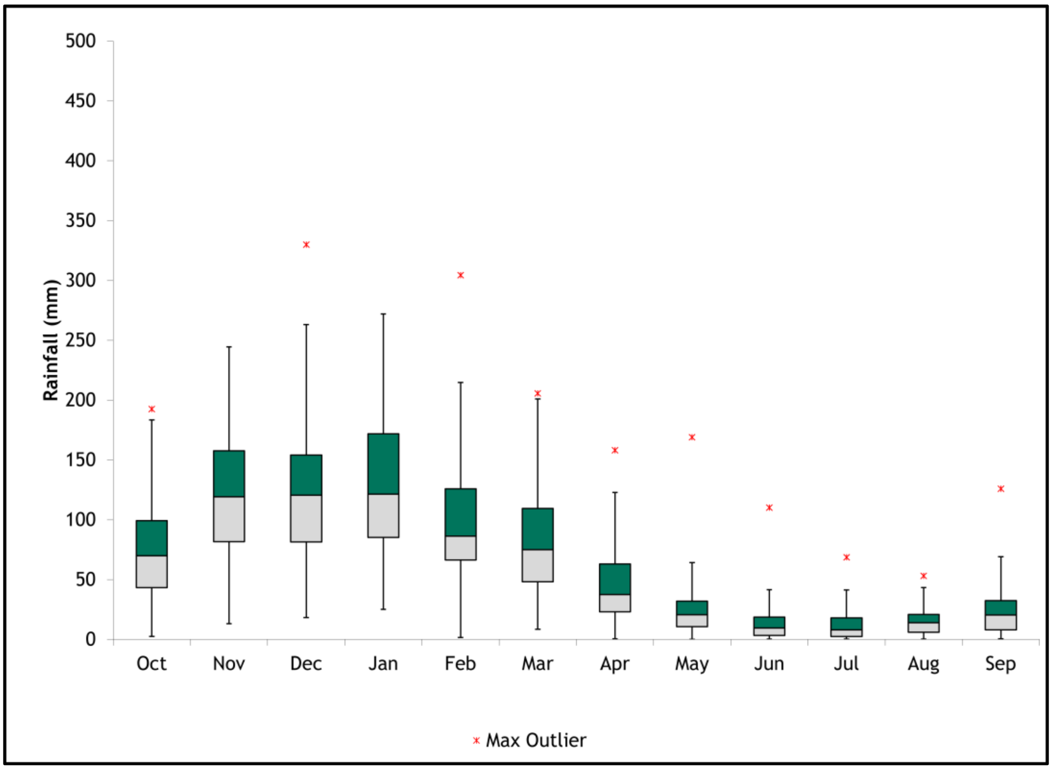

Figure 4-2: Monthly rainfall distribution

Figure 4.2 indicates that January is the wettest month, with an average median rainfall of about 122 mm. The highest monthly rainfall recorded was 330 mm, which occurred in December 1999, which is considered an outlier. August is the driest month, with the highest rainfall ever observed being 53 mm.

4.4 Evaporation

S-pan evaporation monitored at the Naauwpoort @ Witbank Dam (Station B1E001) was used to represent the site evaporation. The mean annual evaporation depth is estimated to be 1 463 mm. The study area falls within the 4A evaporation zone (Midgley et al.,1994). The average S-class pan evaporation rates for the station are presented and plotted against rainfall in Figure 4-3. The evaporation follows a similar trend to the rainfall; evaporation peaks during summer between September and March, reaching a maximum of 164 mm during December. Evaporation decreases during the winter months from May to August, dropping to a minimum of 65 mm during June.

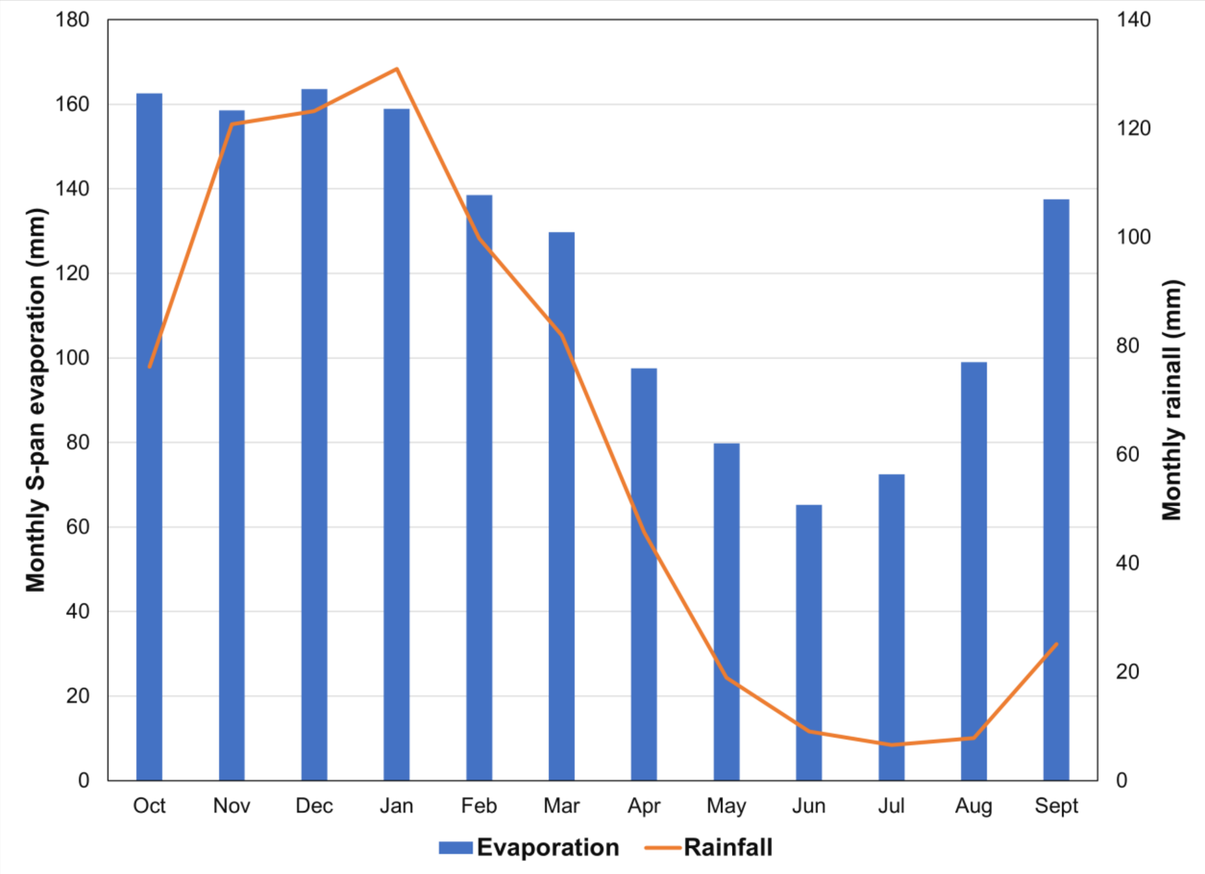

Figure 4-3: Monthly evaporation and rainfall distribution

4.5 Design rainfall

The rainfall analysis was based on the "Design Rainfall Estimation in South Africa" (DRE) program developed by JC Smithers and RE Schulze (Smithers & Schulze, 2002). The program implemented procedures from the Water Research Commission (WRC) project entitled "Rainfall Statistics for Design Flood Estimation in South Africa" (WRC Project K5/1060). More technical information can be obtained from JC Smithers from the School of Bio-resources Engineering and Environmental Hydrology, University of Natal. Rainfall, in the form of storm event intensity, was required for site hydrology calculations. Storm event intensity is data that gives both the depth of rainfall as well as the length of time that rainfall lasted. The 24-hour design rainfall depth for station 0478093 W Ogies (Pol) with various return periods is given in Table 4-1 below.

Table 4-1: Adopted storm rainfall depths (mm)

Duration (hour)	Return period rainfall (mm)						
	1:2	1:5	1:10	1:20	1:50	1:100	1:200
24	53	71.1	84	98.3	115.6	158.2	175.2

5 CONCEPTUAL STORM WATER MANAGEMENT PLAN

A conceptual SWMP for the proposed extension of the Klipspruit Colliery Mine site was developed considering the water resources protection principles provided in the NWA (NWA, 1998), which was implemented in the National Water Resources Strategy. This legislation and regulations were implemented using the BPGs (DWAF, 2007) developed by DWS to plan and manage stormwater in the mine sites.

5.1 Hydrological Modelling

PCSWMM Model, version 7.3 (PCSWMM), was used as a flood analysis model to determine peak discharges and volumes of the delineated sub-catchment areas based on various input parameters at the selected catchment out within the project area and the catchment outlet entering the project area. The PCSWMM is a dynamic rainfall-runoff simulation model used for a single event or long-term simulation of runoff quantity. EPA SWMM 5.1.014 was the selected engine for the model. The PCSWMM Model was used to determine peak flow rates at each outlet node point.

The flood peak flows for the design of the stormwater infrastructures for all expansion project areas were estimated using the Soil Conservation Services (SCS) Method as applied within the PCSWMM stormwater design software package. The flood peaks methods, including the Rational, Alternative Rational, and Standard Design Flood (SDF) methods described in detail in the SANRAL manual (SANRAL, 2013), were used as reference checks for correctness. The stormwater plan was based on the following catchment properties:

- Catchment delineation

Sub-catchments and main catchments were required to be delineated for modelling purposes. This was undertaken based on the following:

    - Position of the existing drainage system and node points; and
    - Position and type of roads which become flow paths.

- Catchment slope

The catchment slopes were determined based on the 0.5 m contour data obtained from the Mine. The process involved the creation of a Digital Elevation Model (DEM) using ArcGIS Pro.

- Catchment land use

An important factor considered during the modelling process is the catchment land use, as this is a defining parameter in the estimation of the percentage of impervious area and, hence, contributes to the runoff potential of an area.

- Impervious areas (Imperv %)

The locations of impervious areas were determined on-site during the site visit and land use file in ArcGIS. The average percentage (%) of imperviousness (Imperv %) was calculated for each of the determined sub-catchments.

- Depression storage (Dstore)

The depression storage depth was calculated using the land use and topographical slope, i.e. different land uses at different slopes provide slightly different depression storage. Depression storage is defined as the ability of a particular area of land, of certain land use, to retain water within its depressions and is expressed as an equivalent millimetre (mm) depth of water.

- Soil type determination

An important parameter of the pervious areas is the soil type, which can consist of either clayey (high runoff potential) soils or sandy (lower runoff potential) soils. The runoff potential is described simplistically, using hydrological soil groupings, which vary from type A (low runoff potential) to type D (high runoff potential).

- Soil Conservation Services Curve Number

The Soil Conservation Services (SCS) Curve Number (CN) is a parameter based on the land use and soil type. The CN describes the runoff potential of a region. Schmidt and Schulze modified the existing SCS CN tables for specific use within the South African context, which took into consideration the diverse hydrological nature of Southern Africa.

5.2 Catchment Delineation

As part of the study, separating the clean and dirty water at the project site is important. The legal framework requirement is to separate clean and dirty water at the project site, as stated in BPG (DWAF, 2007). The background of the guideline is presented in Section 2.2. The 0.5 m contour data were converted into a DEM, and the clean and dirty water catchments were delineated based on the active mining activities. DEM data were also used to determine the expected surface runoff flow direction. Catchment delineation and overland flow direction expected with the current landscape conditions for Pit BD and Pit H are depicted in Figure 5-1 and 5-2.

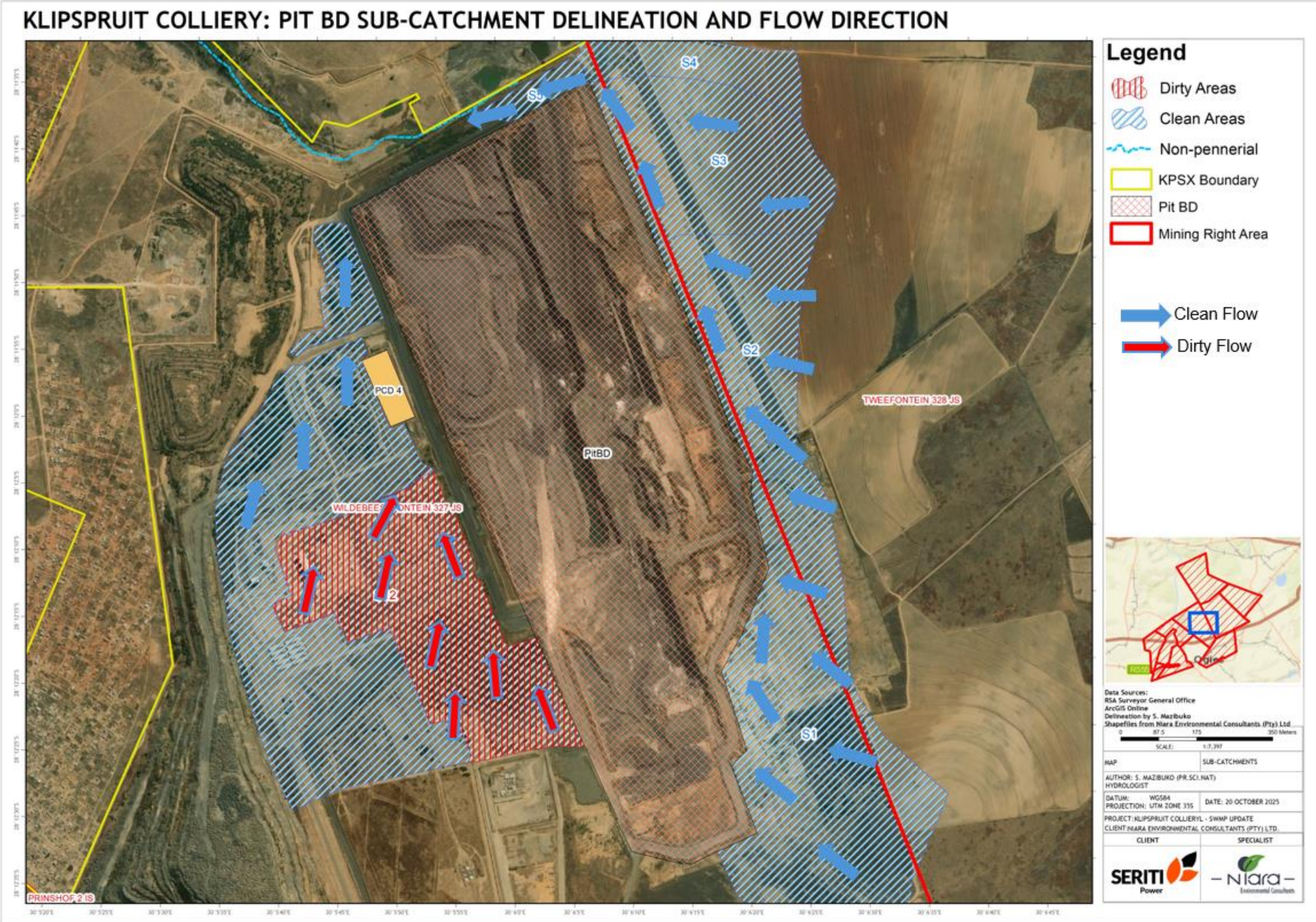

Figure 5-1: Dirty and clean water catchment delineation and flow direction for Pit BD

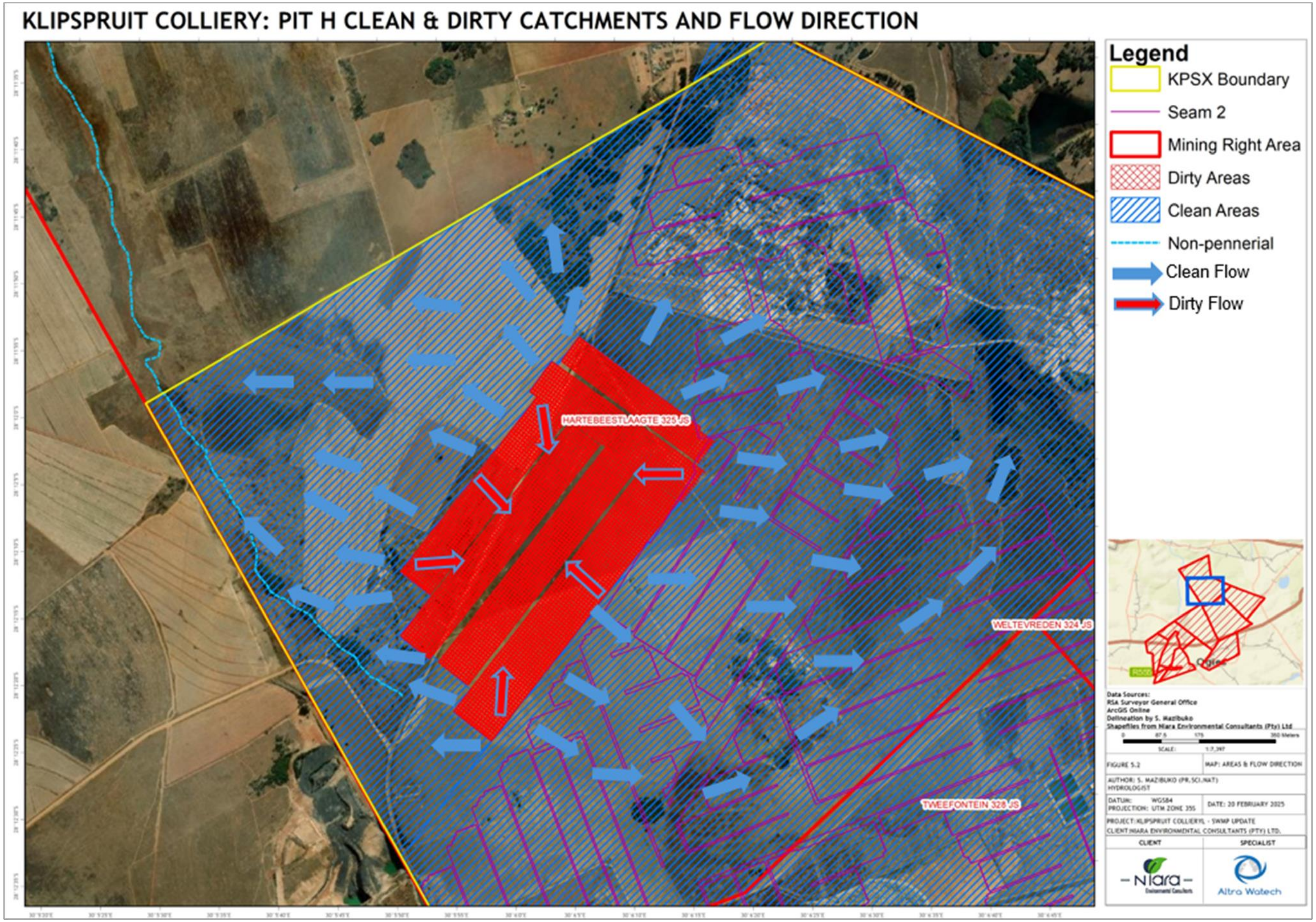

Figure 5-2: Dirty and clean water catchment delineation and flow direction for Pit H

5.3 Peak Flow Estimation

Catchment delineation (in Figure 5-2) show that Pit H is located in a highly elevated area, and as a result, dirty water will accumulate in the pit naturally, eliminating the need to redirect clean water away from it. Thus, the hydrological and hydraulic parameters of the catchments were calculated in the Pit BD areas, and the overland peak flow rates were determined. The magnitude of the flood peak depends on the catchment characteristics and the rainfall intensity. The peak flow rates of the catchments indicate the amount of water flowing through a specific outlet over time and are determined by the catchment's hydrology. The peaks serve as baseline data in determining the design criteria for a specific surface water structure. Peak flow estimation volumes for the clean catchment areas are provided in Table 5-1 and shown in Figure 5-3.

Table 5-1: Pit BD clean catchment area characteristics

Catchment ID	Area (km^2)	Slope (%)	Impervious	Depression Storage Impervious (mm)	Depression Storage Pervious (mm)	Peak Runoff (m^3/s)
S1	0.85	2.4	5	2.5	3	4.32
S2	0.30	2.7	5	2.5	3	1.58
S3	0.37	2.4	5	2.5	3	2.2
S4	0.13	2.6	5	2.5	3	0.77
S5	0.04	3.6	5	2.5	3	0.23
S6	0.03	1.7	5	2.5	3	0.16
S7	0.02	2.0	5	2.5	3	0.1

5.4 Dirty Water Containment

In terms of GNR 704 and BPGs, all dirty water must be captured in holding facilities with the capacity to contain the 1:50-year flood event. The dirty runoff water from the Pit BD area and PCD footprint areas will be captured and contained for use in mining activities (e.g., dust suppression). Also, dirty water accumulating in Pit BD and Pit H will be pumped into PCD 4 and PCD 1, respectively. In terms of GNR 704, all dirty water must be collected and captured in holding facilities so that it does not spill more than once in 50 years. The anticipated volumes of water flowing onto both pit areas and respective PCDs were determined using the SCS method, which uses a Curve Number (CN) to account for soil conditions and initial abstraction by the surface on which the rain falls and over which the water will flow. A CN of 70 and 90 were selected to represent the contributing catchment conditions. The SCS runoff volume results for the dirty water areas in both pits (for 1:50-year flood events) are shown in Table 5-2.

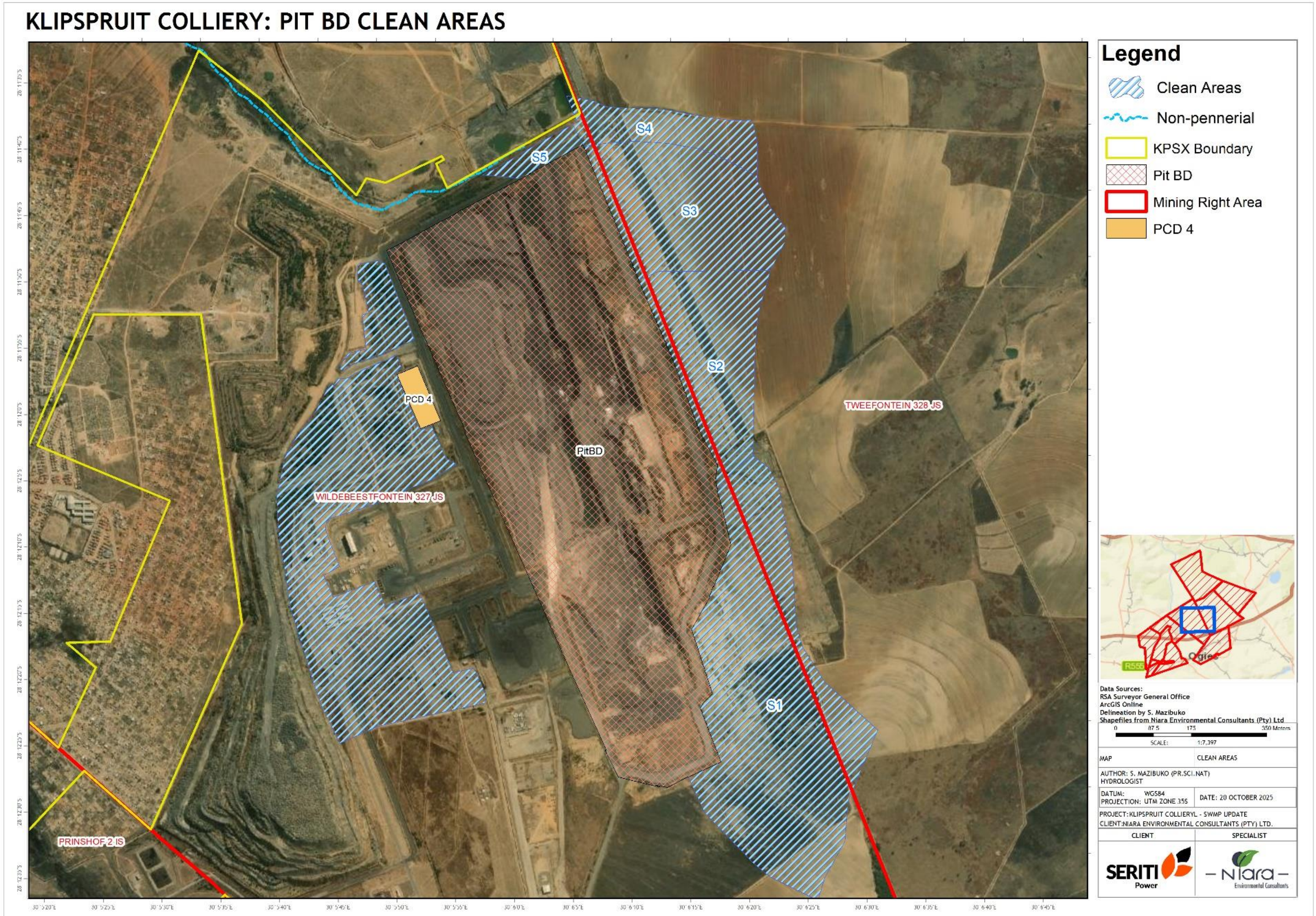

Figure 5-3: Clean water catchment areas in the Pit BD area

Table 5-2: Dirty catchment area characteristics

Catchment ID	Area (km^2)	Slope (%)	Depression Storage Impervious (mm)	Depression Storage Pervious (mm)	Runoff volume (m^3)	Peak Runoff (m^3/s)
Pit BD	2.20	1.7	0.05	0.05	210 760	52.98
S12	1.19	1.2	0.05	0.05	36 760	10.1
Pit H	1.53	0.5	0.05	0.05	128 450	48.05

5.5 Mean Annual Runoff

According to the revised water management area boundary descriptions (Government Gazette No. 35517), quaternary catchment B20G has a Mean Annual Runoff (MAR) of 23.04 million cubic meters (mcm). The anticipated reduction in MAR because of the proposed expansion project will have a negligible impact, if any.

5.6 Berms and Channels

Developing a SWMP berm creates a barrier between clean and dirty areas by diverting clean water away from the dirty area and ensuring that dirty water is contained within it. Open drainage channels convey dirty runoff from the dirty water areas to the water containment facility, such as a PCD, which will be used in this study. The berms should be vegetated with indigenous vegetation to prevent erosion. A typical berm and channel structure is presented in Figure 5-4. GN R704 requires that clean and dirty water systems be designed, constructed, maintained, and operated so they do not spill more than once in 50 years. The peak flows were calculated using the Rational Method described previously in the section. Manning's equation was used to calculate the conceptual trapezoidal channel sizes. The Manning's equation is described below.

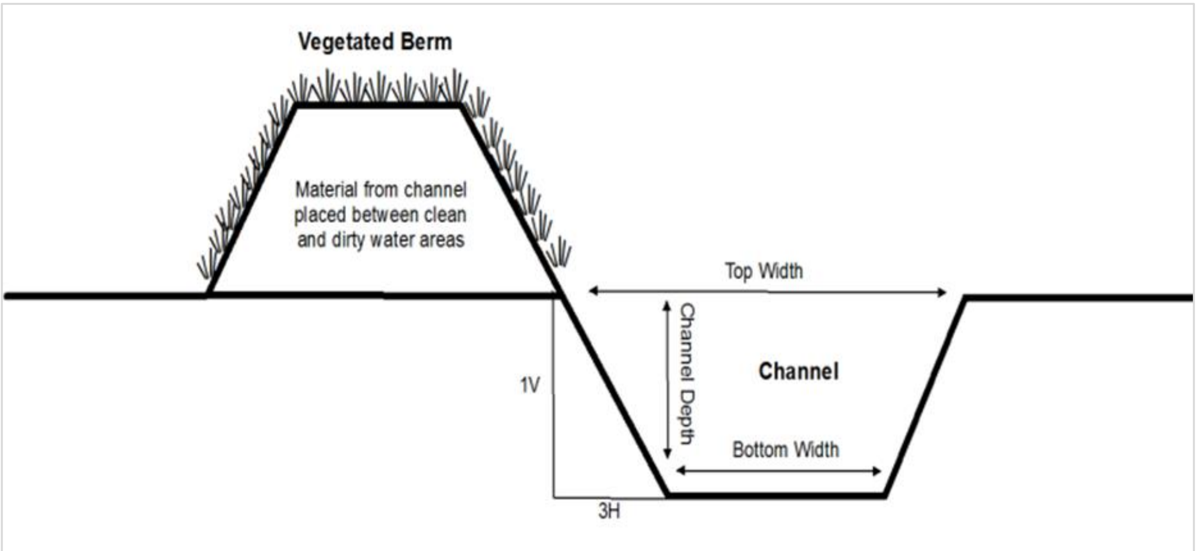

Figure 5-4: Proposed conceptual berm and drainage channel

A Manning roughness coefficient of 0.01-0.04 was used for the channel calculations. The clean water channels will likely be earth-lined. The spatial extent of the clean channel together with the discharge point to the environment are mapped in Figure 5-5 and Figure 5-6. The calculated velocity at the conduit to the discharge point was calculated at 3.2m/s which requires that an energy dissipating structure be constructed at the outlet point to reduce the erosion potential of stormwater. The summary of the proposed upgrades of the channel sizes are provided in Table 5-3.

Table 5-3: Upgraded clean channel attributes related to stormwater around the Pit BD area

Channel ID	Side Slopes (1: H)	Channel Bottom Width (m)	Channel Depth (m)	Channel slope (m/m)	Velocity (m/s)	Froude No	1:50-yr Peak Flow (m^3/s)
C1	2	2	1.2	0.015	2.2	0.9	4.32
C2	2	2.5	2	0.006	1.3	0.6	5.08
C3	2	2.5	2	0.008	1.7	0.7	6.61
C4	2	2.5	2	0.009	2.2	0.7	7.06
C5	2	4	2.5	0.034	3.2	0.9	7.23

A temporary, dirty-water channel is required on the southwestern flank of Pit BD to capture runoff from the road leading into the pit. The dirty water is being diverted rather than flowing into Pit BD. A clean water separating berm around Pit H is required and should be designed as per the conceptual design depicted in Figure 5-4 to ensure that all clean water runoff generated in the Pit H area is diverted to the environment.

Dirty runoff into the Pit H area and groundwater ingress will accumulate in the proposed pit sump. As part of mine water management, this dirty water needs to be pumped from a sump to PCD 1 to support reuse for dust suppression on haul roads and plant operations. This is based on the assumption that the box cut for Pit H will remain in the same position throughout the Life of Mine (LoM). However, if the mine opts for open-cast mining within the farm portion of Pit H, changes to the SWMP will be necessary to account for topographic variation resulting from relocating the box cut and landscape rehabilitation, which is likely to affect local runoff regimes in the area.

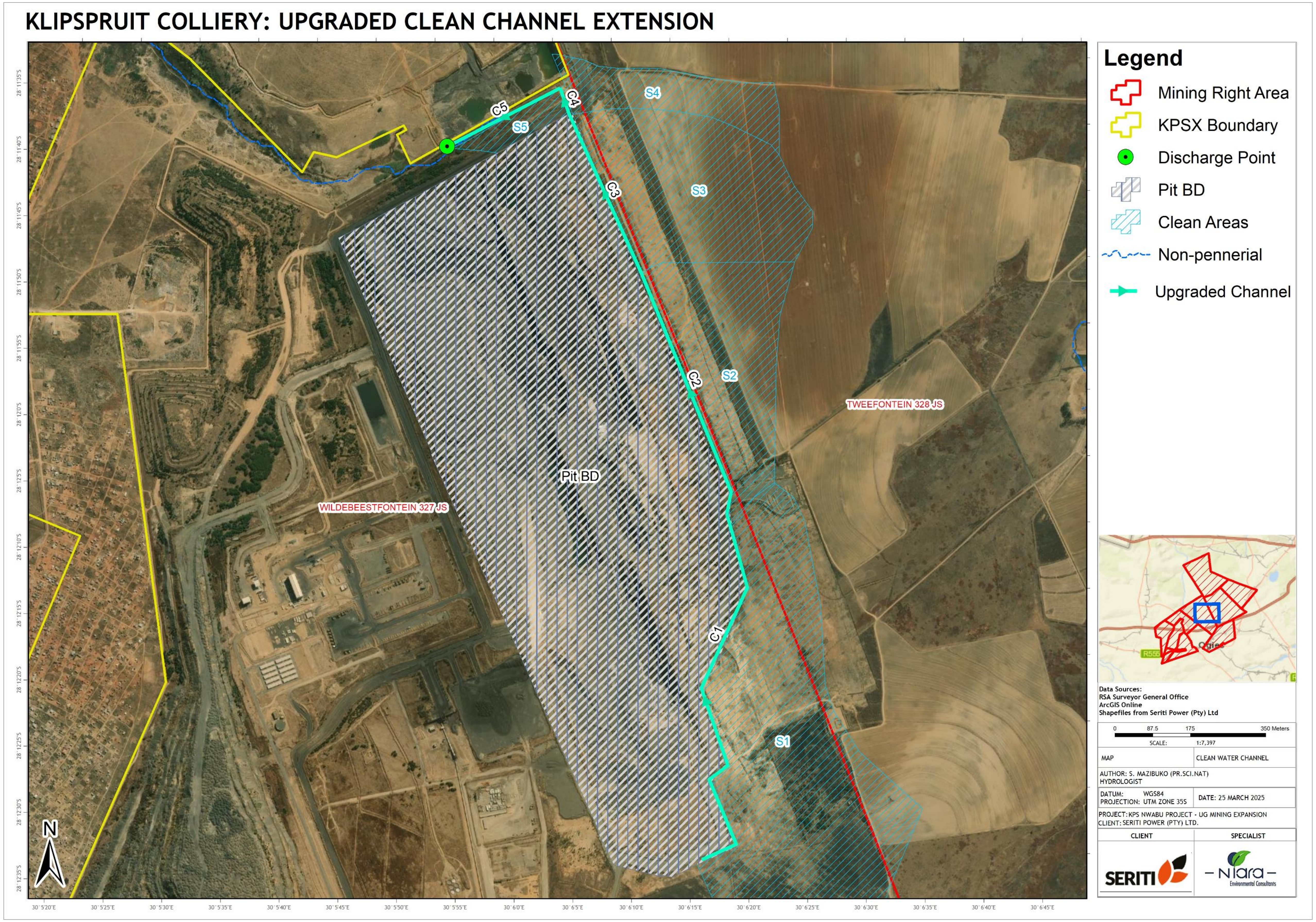

Figure 5-5: Proposed clean diversion upgrade channel

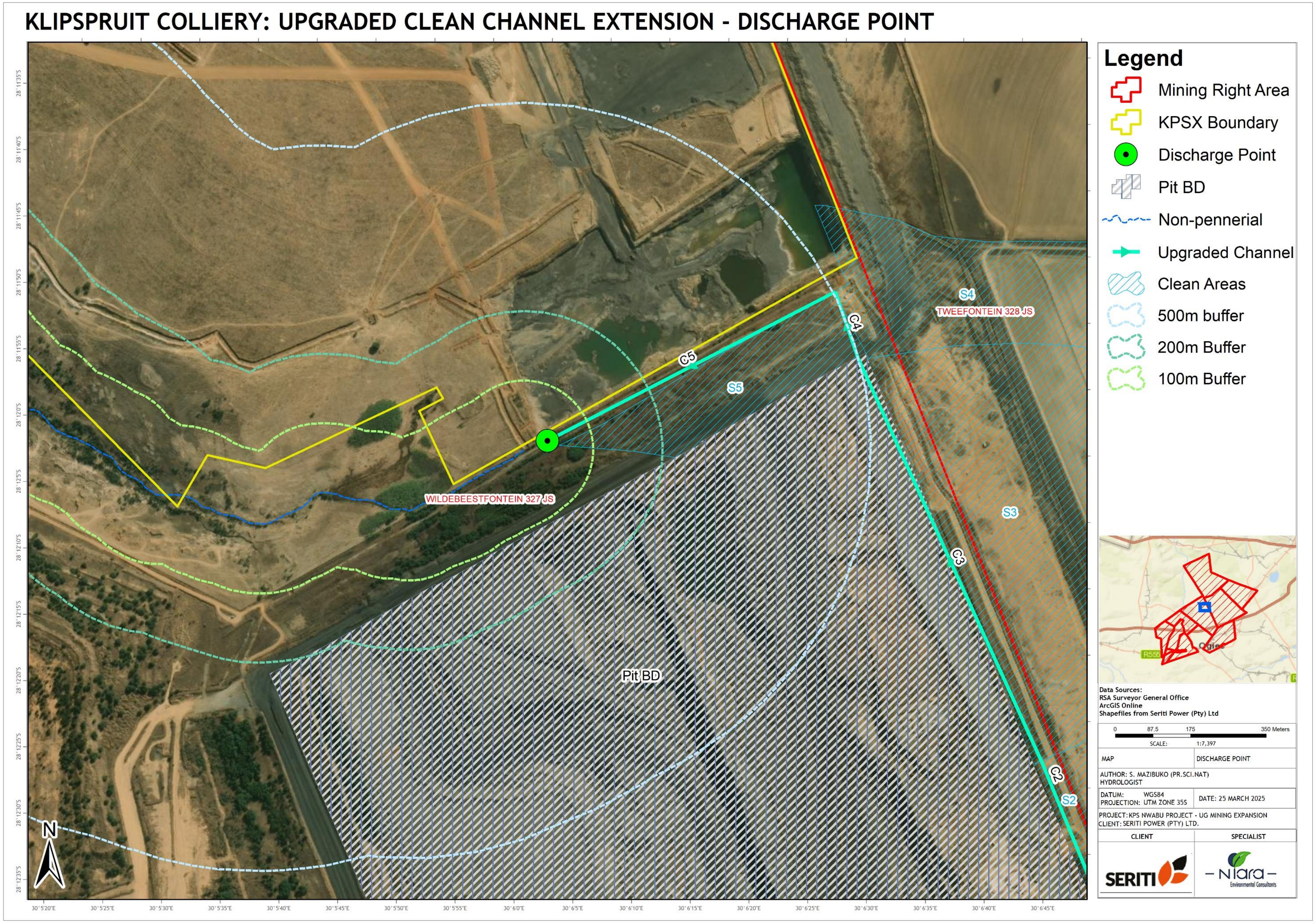

Figure 5-6: Proposed clean diversion discharge point

5.7 Conceptual Storm Water Management Plan

The overall conceptual SWMP layout for Pit BD is shown in Figure 5-7. This update is characterised by the extension of the existing clean channel to ensure that all clean runoff generated is routed through the channel and discharged into the environment via the discharge point, located in the headwater reaches of the non-perennial drainage in the northern part of the Pit BD. The upper reaches where there is a stockpile loading area collects dirty runoff and route it to PCD 4 via the confluence with the existing dirty concrete channel. Also, all dirty water from the workshop area is routed through the existing channels to PCD 4. Areas along the left edge of Pit BD area will divert their dirty runoff into the pit which will be collected from Sump 2..

The proposed SWMP layout for Pit H is presented graphically in Figure 5-8. The figure shows that, because the pit is located on relatively high terrain, most of the overland runoff from the clean water areas will radially flow from the open pit to the natural drainage channels. However, to prevent additional clean water from entering the pit and mixing with dirty water, a berm is proposed around the open pit area, as shown in the figure. Further justification for this berm is that, if the mine plans to use open-cast mining on the property, the principle of GN704 will be implemented. In the event that open-cast mining is planned, it is worth noting that an unnamed non-perennial stream drains the south-western corner of Pit H, necessitating an update to this proposed SWMP to account for all phases of mining and river diversion.

Dirty water accumulating in Pit H will be collected by a sump located at the lowest point of the pit. Based on the calculated peak flow volumes, an estimate of 128 450m^3 will be generated. This volume can be pumped into the closest wastewater storage facility, such as PCD 1, for reuse to support the mine operations.

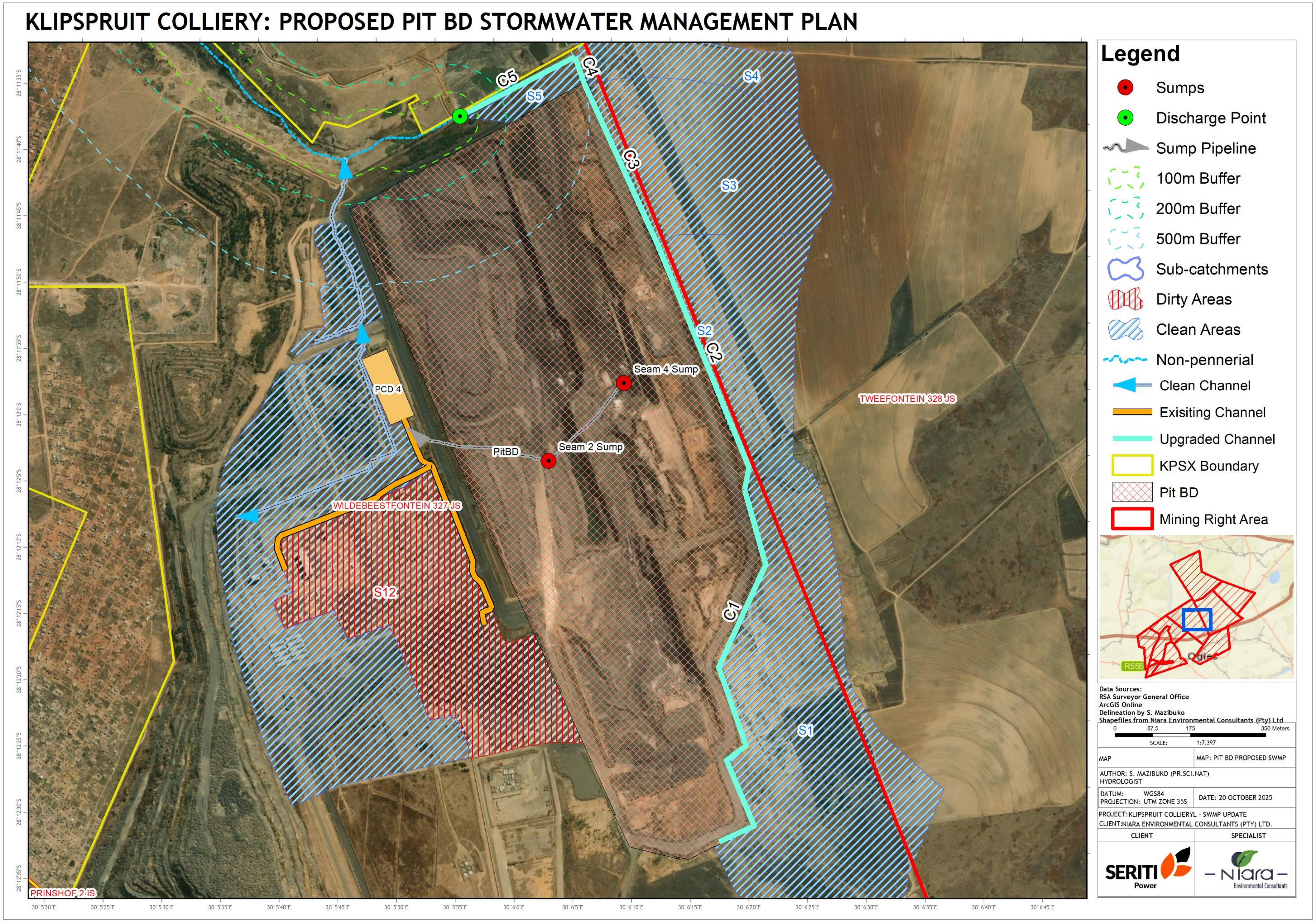

Figure 5-7: SWMP update layout for Pit BD

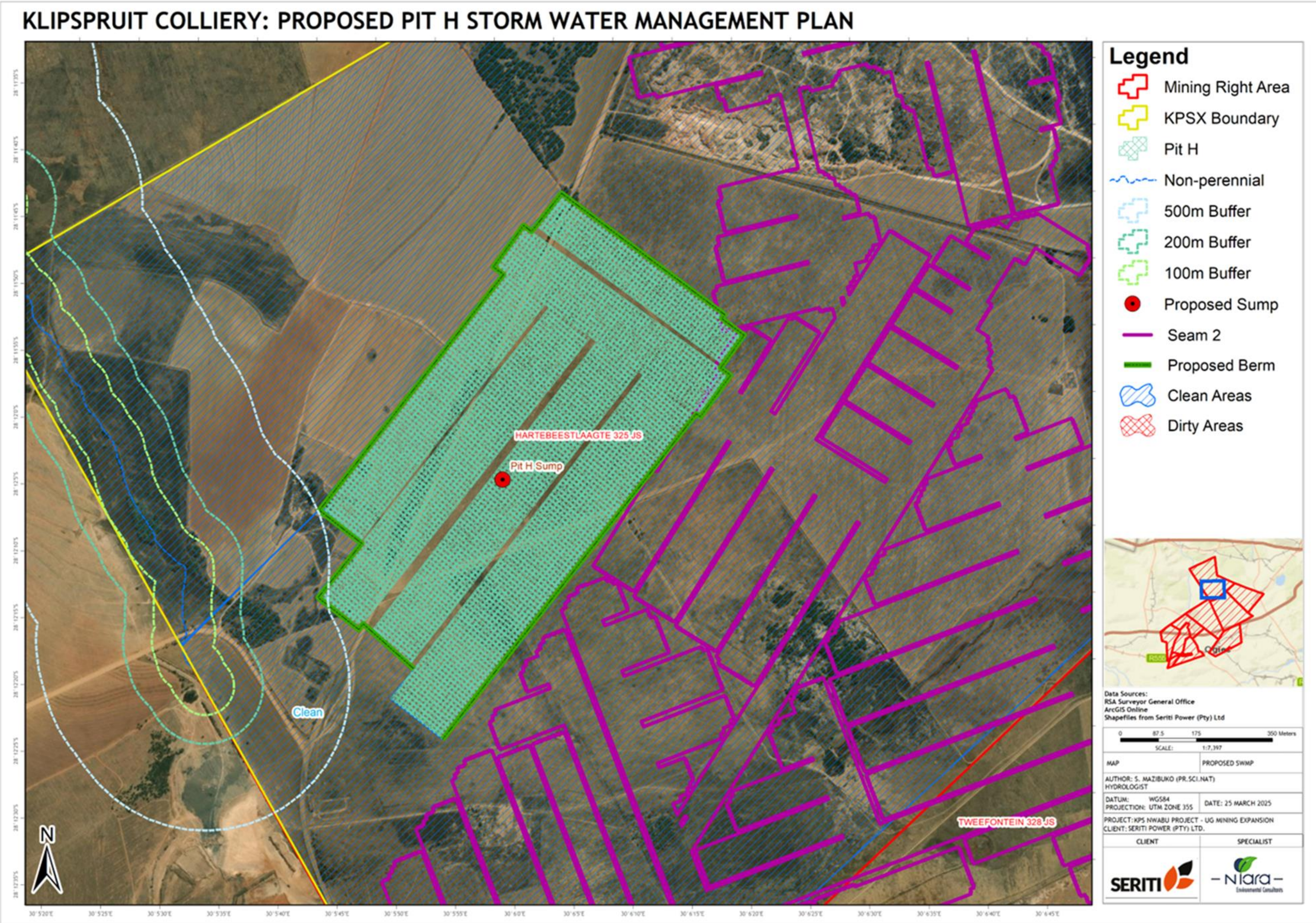

Figure 5-8: Proposed SWMP layout for Pit H

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The following conclusions and recommendations were derived from the SWMP study:

- The existing clean water diversion bund sizing was upgraded to handle the 1:50-year flood events. The focus was mainly on the eastern part of the Pit BD as the western part has the already existing system that divert clean water away from the dirty water areas.
- The estimated volume of dirty water that needs to be contained in PCD 4 from Pit BD is 210 760 m^3. The total volume of dirty water to be contained in PCD 4 – based on the updated layout provided in this study – is 297 290 m^3. This volume represents surface runoff only and does not include groundwater ingress or seepage, which will be assessed separately as part of the pit water balance study.
- A diversion berm is required on the southwestern flank of Pit BD to contain dirty water emanating from the haul roads and directing dirty runoff into Sump 2 of the pit.
- Pit H is located on a relatively hilly surface, and the expected overland runoff regimes – based on the 0.5 m survey data – show that flow will be directed away from the box cut of the pit. Thus, only the pit area was classified as a dirty catchment area, while the surrounding areas will remain clean water areas, as the mine uses underground mining methods through this pit.
- The estimated volume of dirty water that needs to be contained from Pit H is 128 450 m^3 and is expected to be pumped from the proposed collecting (inside the pit) to PCD 1 for reuse.
- A stormwater berm surrounding the pit area is proposed to prevent entrenched clean runoff from entering the Pit, while an update of SWMP with a diversion will be required on the southwestern flank of Pit H if Seriti Power revert to open-cast mining methods in the future.

6.2 Recommendations

The following recommendations derived from this study are outlined as follows:

- It is recommended that the water management operations of PCD 4 be revised to account for additional dirty water inflows (Pit BD and dirty runoff) resulting from the update from this study.

- The clean water diversion discharge point is steep; thus, it is recommended that it be designed as a stepped chute. Implement erosion control measures, such as adding vegetation, using erosion control blankets, or installing sedimentation basins to prevent soil erosion within and around the discharge points.
- It is also recommended that the existing dirty water channel discharging to PCD 4 be regularly maintained reduce the siltation levels blockages particularly after the heavy storm events. Thus, maintain the quality and effectiveness of the stormwater system through an ongoing operations and maintenance program.
- A prioritisation of the required stormwater system to manage, complete and maintain the road in the short, medium and long term.
- Maintain and upgrade stormwater infrastructure.
    - Implement a monitoring plan to assess the performance of culverts/stormwater pipes over time.
    - Implementation of the stormwater pipe and damaged road inspection programs.
    - Replace undersized or damaged pipes and catch pits to ensure system integrity.
    - Repair failing stormwater outfalls to ensure system integrity and minimise adverse impacts on downstream properties and streams.
    - Add new culverts in areas where there is a shortage of stormwater pipes to help alleviate road flooding.
- Any specialist studies, including the environmental compliance studies that might be needed, must be done in consultation with relevant authorities.
- The outlet channels need to be regularly maintained to prevent blockages that may cause overflow and possible flooding.

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