WATT & WITPOORTJIE SOLAR PV

STORMWATER MANAGEMENT PLAN

28TH February 2025
Version 1

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CONSULTING ENGINEERS

VERIFICATION PAGE

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EXECUTIVE SUMMARY

Objective

SKERP Consulting Engineers was initially appointed by **Watt Solar PV (Pty) Ltd** and **Witpoortjie Solar PV (Pty) Ltd** (hereafter referred to as “Watt & Witpoortjie Solar PV”) to complete a Stormwater Management Plan (SWMP) for the proposed **80MW$_{AC}$ Watt Solar PV** & **40MW$_{AC}$ Witpoortjie Solar PV** and associated grid infrastructure (hereafter referred to as the "proposed facility / facilities / development") in February 2024. The facility is situated ±8 km west of Brakpan within the City of Ekurhuleni Metropolitan Municipality in the Gauteng Province.

The proposed **Watt & Witpoortjie Solar PV** forms part of a cluster development, with each PV area being treated as separate EIA applications: Watt Solar PV (Pty) Ltd and Witpoortjie Solar PV (Pty) Ltd. Both developments were considered in this study in a combined report as they share common boundaries, drainage lines, and catchments.

Following the initial SWMP submission, an additional appointment was received to address queries regarding the intended Water Use Licence Application (WULA) for the access road crossing the Rietspruit that bisects the proposed development. As this additional query is part of the original report, it was decided to incorporate the further study into the existing report.

This report, therefore, encompasses the development's desktop SWMP, the external flood inundation area, and the proposed road crossing forming part of the WULA.

Key Findings

No significant risks concerning the proposed development are foreseen, provided the recommendations below are noted before and during the detailed design and construction stages. Furthermore, several recommendations were highlighted and therefore noted as necessary.

The proposed development / infrastructure, located within / close to a Dolomitic area will have a minimal impact on the stormwater quality and quantities post-development (operational phase). This development's construction phase typically generates the highest surface run-off if coinciding with the wet season. However, it will be temporary, and impacts can be mitigated and considered nominal. The post-development stormwater flow from the operation phase will have a minimal impact on the immediate environment if adequate stormwater designs are implemented to maintain existing drainage patterns and flows in the catchments.

Several mitigation measures are proposed to accommodate the development and reduce its impact on the surrounding area. The findings and recommendations from the Dolomitic Study will further guide this Stormwater Management Plan.

Recommendation

Concerning this report, associated assessment, and the findings made within, SKERP Consulting Engineers believes that the **Watt & Witpoortjie Solar PV** and associated grid infrastructure will have a nominal impact on the existing stormwater catchments. The project is therefore deemed acceptable from a stormwater perspective, provided this report's recommendations and mitigation measures are implemented. Hence, Environmental Authorisation (EA) should be granted for the EIA application.

This document should also be read in conjunction with the EMPr. The developer, owner, and professional team shall adhere to the requirements and conditions set out in the EMPr.

DECLARATION BY SPECIALIST

I, MERCHANDT LE MAITRE, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application objectively, 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 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;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence.

Signature of Specialist:

Name of Company: SKERP Consulting Engineers (Pty) Ltd

Date: 28th February 2025

WATT & WITPOORTJIE SOLAR PV

STORMWATER MANAGEMENT PLAN

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1. INTRODUCTION

SKERP Consulting Engineers was initially appointed by **Watt Solar PV (Pty) Ltd** and **Witpoortjie Solar PV (Pty) Ltd** (hereafter referred to as “Watt & Witpoortjie Solar PV”) to complete a Stormwater Management Plan (SWMP) for the proposed **80MW$_{AC}$ Watt Solar PV** & **40MW$_{AC}$ Witpoortjie Solar PV** and associated grid infrastructure (hereafter referred to as the "proposed facility / facilities / development") in February 2024. The facility is situated ±8 km west of Brakpan within the City of Ekurhuleni Metropolitan Municipality in the Gauteng Province.

The proposed facility and associated grid infrastructure between Brakpan, Boksburg and Vosloorus are not within a Renewable Energy Development Zone (REDZ).

The proposed **Watt & Witpoortjie Solar PV** forms part of a cluster development, with each PV area being treated as separate EIA applications: Watt Solar PV (Pty) Ltd and Witpoortjie Solar PV (Pty) Ltd. Both developments were considered in this study in a combined report as they share common boundaries, drainage liness and catchments.

The development details for each Solar PV are indicated below:

Watt Solar PV	Coverage (ha)	MW	Permanent Footprint (ha)
PV1	43.53		35.16
PV2	33.54		30.42
PV3	11.06		8.72
PV4	3.59		2.92
TOTAL	**91.72**	**80**	**77.22**

Witpoortjie Solar PV	Coverage (ha)	MW	Permanent Footprint (ha)
PV1	34.87		18.22
PV2	11.66		10.88
TOTAL	**46.53**	**40**	**29.11**

Following the initial SWMP submission, an additional appointment was received to address queries regarding the intended Water Use Licence Application (WULA) for the access road crossing the Rietspruit that bisects the proposed development. As this additional query is part of the original report, it was decided to incorporate the further study into the existing report.

This report, therefore, encompasses the development's desktop SWMP, the external flood inundation area, and the proposed road crossing forming part of the WULA.

2. SOLAR PV FACILITY COMPONENTS

The Solar PV facilities will consist of the following:

2.1 Watt Solar PV Facility Components

The development area is proposed to accommodate both the 80MW solar PV facility as well as most of the associated infrastructure which is required for such a facility and will include:

- Solar PV arrays, modules and mounting structures
- Inverters and transformers
- Cabling between the project components
- Battery Energy Storage System (BESS) – Shared with Witpoortjie Solar PV Facility
- On-site facility substation – Shared with Witpoortjie Solar PV Facility
- Temporary and permanent laydown areas, O&M buildings, security infrastructure, and fencing around the development area – Shared with Witpoortjie Solar PV Facility
- Site and internal access roads up to 6m in width, where required.

2.1 Witpoortjie Solar PV Facility Components

The development area is proposed to accommodate both the 40MW solar PV facility as well as most of the associated infrastructure which is required for such a facility and will include:

- Solar PV arrays, modules and mounting structures
- Inverters and transformers
- Cabling between the project components
- Battery Energy Storage System (BESS) – Shared with Watt Solar PV Facility
- On-site facility substation – Shared with Watt Solar PV Facility
- Temporary and permanent laydown areas, O&M buildings, security infrastructure, and fencing around the development area. Shared with Watt Solar PV Facility
- Site and internal access roads up to 6m in width, where required.

2.2 Grid Connection Components

The electrical grid infrastructure (EGI) will connect via an on-site substation adjacent to Barry Marais Road (Road M43), which ties into the existing Eskom grid.

3. OBJECTIVE AND SCOPE OF WORK

The study's main objective is to develop a conceptual stormwater management plan for the proposed development during the operation & maintenance phase. To achieve this objective, the following will be assessed and discussed under their relevant headings in this report: -

- Climate
- Surface Hydrology
- Development Stormwater Management
- Development run-off Calculations
- Conclusions & Recommendations

The scope of work consists of the following:

a) A site investigation completed on the 11th February 2025.

b) Consultations with the relevant authorities and / or stakeholders.

c) Extract the climate of the area from sources commonly available.

d) Desktop analysis of the existing surface hydrology

e) Evaluate the impact of the proposed development on the existing catchment and propose a suitable SWMP.

f) Conclude and propose possible mitigation measures.

g) Seasonal impacts affect this assessment.

3.1 Legal Requirements & Guidelines

Key legal requirements and guidelines for the proposed facilities are as follows:

- Government Notice 509 (GN509), as published in Government Gazette 40229 of 2016 and refers to the National Water Act, 1998 (Act No. 36 of 1998)
- National Environmental Management Act, 1998 (Act No 107 of 1998) (NEMA)
- National Water Act, 1998 (Act No 36 of 1998) (NWA)

4. SPECIALIST CREDENTIALS

Merchandt Le Maitre from SKERP has compiled this Stormwater Management Plan. He has a B Tech (Baccalaureus Technologiae) in Civil Engineering with over 19 years of experience, with 13 years in renewable energy. His extensive experience in the different facets of Civil Engineering means he can advise clients in the renewable energy sector in geotechnical engineering, topographical studies, stormwater management, water demand, transportation studies, access and internal layout designs and Glint and Glare Assessments. A full Curriculum Vitae is included in 'Appendix A.'

5. ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are to be noted:

- The analysis is based on the information Merchant Energy and its representatives provided at the time.
- Digital Surface Model:
  - Catchments: 30m DSM from ALOS World 3D & 25m NGI DEM
  - Flood Modeling: City of Ekurhuleni LiDAR 0.5m (September 2018)
- Technical Specifications for the facility are:

Table 5-1 Details the Watt Solar PV Facility and associated infrastructure

Component	Description / Dimensions
Contracted capacity of the facility	Up to $80MW_{AC}$
Total extent of the Affected Property	~225ha
Total extent of the Development area[4]	Up to ~225ha
Total extent of the Development footprint[5]	~86ha
Technology	Monofacial or Bifacial PV panels mounted on either fixed-tilt, single-axis tracking and/or double-axis tracking systems
PV panels	Height: up to 5m from ground level (installed)
On-site Facility Substation, Switching Station, Battery Energy Storage System	• Located within the development area.

(BESS) – Shared between Watt & Witpoortjie Solar PV Facilities	• Up to 9ha in extent. • Substation infrastructure up to 15m in height. • BESS infrastructure up to 10m in height
Access roads and internal roads	• Existing roads will be used, wherever possible, to access the development area. • Access and internal roads up to 6m in width will be required to access the PV panels and on-site substation.
Other infrastructure – Shared between Watt & Witpoortjie Solar PV Facilities	• O&M buildings • Offices, operational control centre, operation and maintenance area, ablution facilities. laydown areas • Warehouse and workshop • Perimeter fencing

Table 5-2 Details the Witpoortjie Solar PV Facility and associated infrastructure

Component	Description / Dimensions
Contracted capacity of the facility	Up to 40MW_{AC}
Total extent of the Development area[4]	Up to ~65ha
Total extent of the Development footprint[5]	~38ha
Technology	Monofacial or Bifacial PV panels mounted on either fixed-tilt, single-axis tracking and/or double-axis tracking systems
PV panels	Height: up to 5m from ground level (installed)
On-site Facility Substation, Switching Station, Battery Energy Storage System (BESS) – Shared between Watt & Witpoortjie Solar PV Facilities	• Located within the development area. • Up to 9ha in extent. • Substation infrastructure up to 15m in height. • BESS infrastructure up to 10m in height
Access roads and internal roads	• Existing roads will be used, wherever possible, to access the development area. • Access and internal roads up to 6m in width will be required to access the PV panels and on-site substation.
Other infrastructure – Shared between Watt & Witpoortjie Solar PV Facilities	• O&M buildings • Offices, operational control centre, operation and maintenance area, ablution facilities. laydown areas • Warehouse and workshop • Perimeter fencing

- The development area is that identified area where the 80MW / 40MW PV facility is planned to be located, within which indirect and direct effects of the project may occur. Considering technical preference and constraints, this area has been selected as a practicable option for the facility. The development area is ~225ha / 65ha in extent.

- The development footprint is the defined area (located within the development area) where the PV panel array and other associated infrastructure for the Watt & Witpoortjie Solar PV facility are planned to be constructed. This is the facility's actual footprint and the area that would be disturbed. Each area includes the common 9 ha for the shared facilities.
- Some of the figures provided are indicative as many of the components are still at the design stage and will only be confirmed closer to the time of construction.

6. PROJECT DESCRIPTION

6.1 Locality

The Watt & Witpoortjie Solar PV facility and associated infrastructure are located ±8 km west of Brakpan in the Gauteng Province. Barry Marais Road (M43) between Brakpan and Vosloorus borders the facility on the northern boundary. (Refer *Figure 6-1* below).

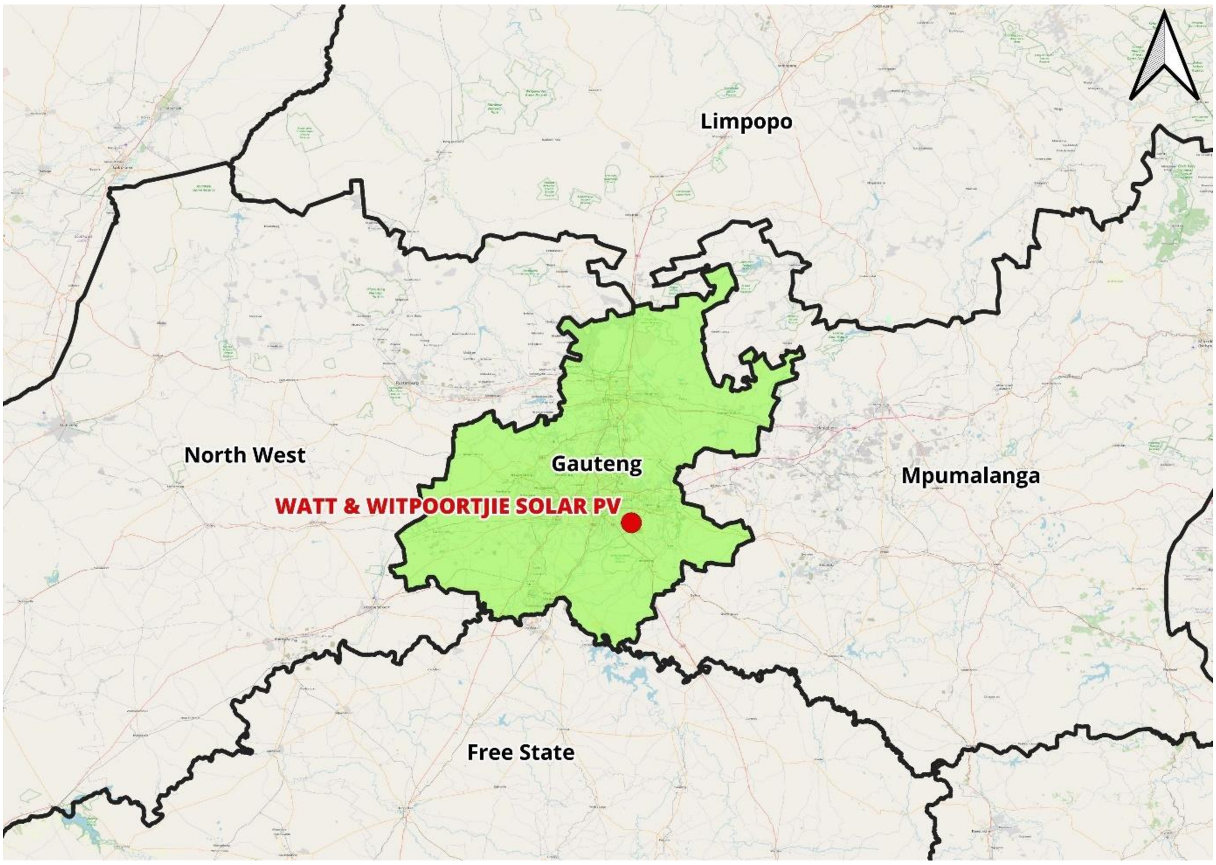

Figure 6-1 Watt & Witpoortjie Solar PV Facility - Regional Context

The **Watt Solar PV** project site covers approximately 225 ha and comprises the following farm portion (Refer to *Figure 6-2*).

- Portion 30 of the Farm Rooikraal 156 IR
- Portion 29 of the Farm Rooikraal 156 IR

The **Witpoortjie Solar PV** project site covers approximately 65 ha and comprises the following farm portions (Refer to *Figure 6-2*).

- Portion 47 of the Farm Witpoortje 117 IR,
- Portion 56 of the Farm Witpoortje 117 IR,
- Portion 5 of the Farm Witpoortje 117 IR

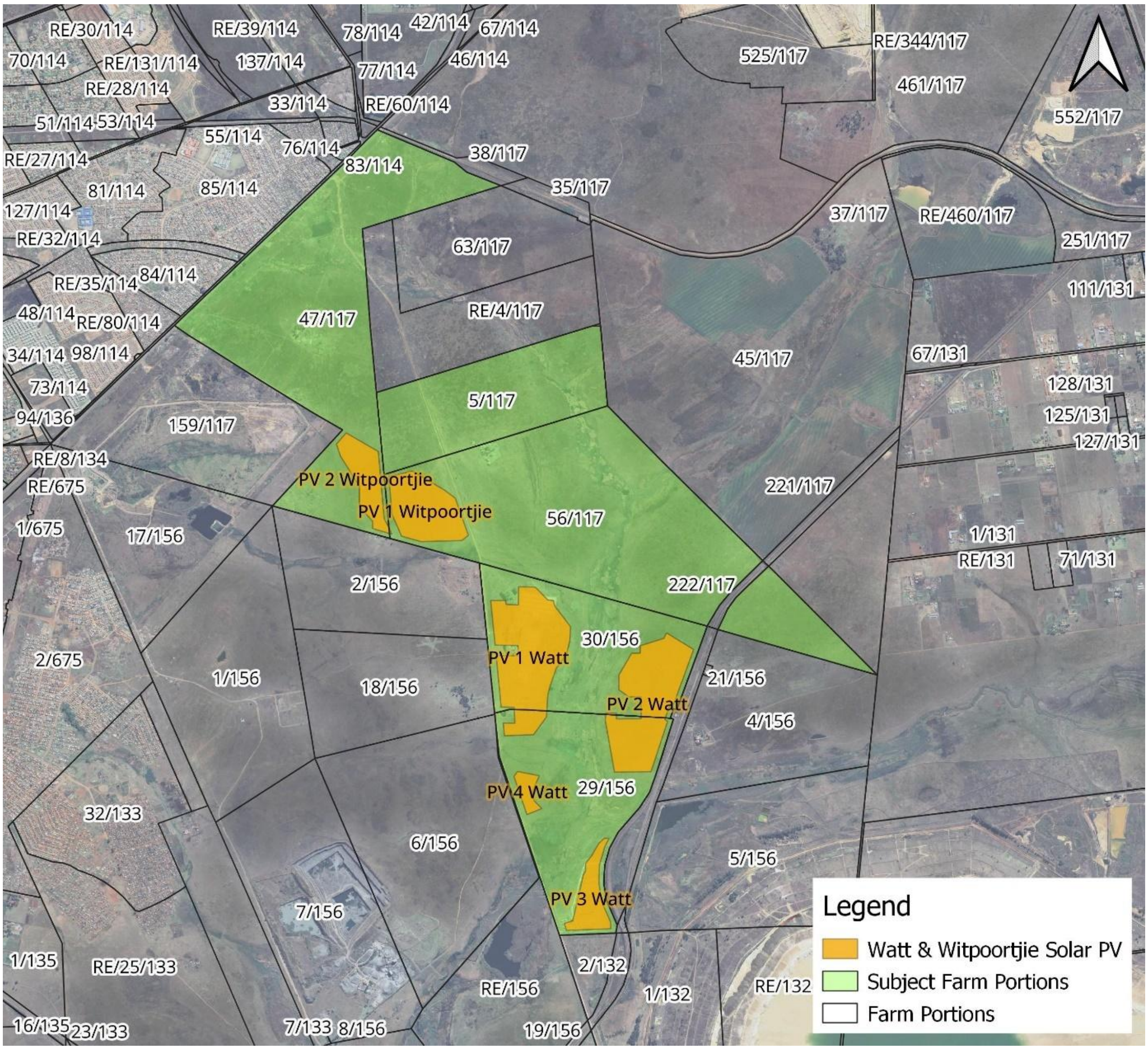

Figure 6-2 Watt & Witpoortjie Solar PV - Site Locality

7. GEOTECHNICAL STUDY

7.1 Palaeontology Impact Assessment

A Palaeontology Impact Assessment[1] for the proposed development was completed in September 2023 by CTS Heritage on the proposed sites indicated in **Section 6**.

A summary extract from the Study confirmed the site's Geotechnical context. Refer *Figure 7-1*.

[1] CTS Heritage, Dr Kimberley Chapelle (2023) - *Proposed Development of The Watt And Witpoortjie Solar PV Facility in the Gauteng Province*

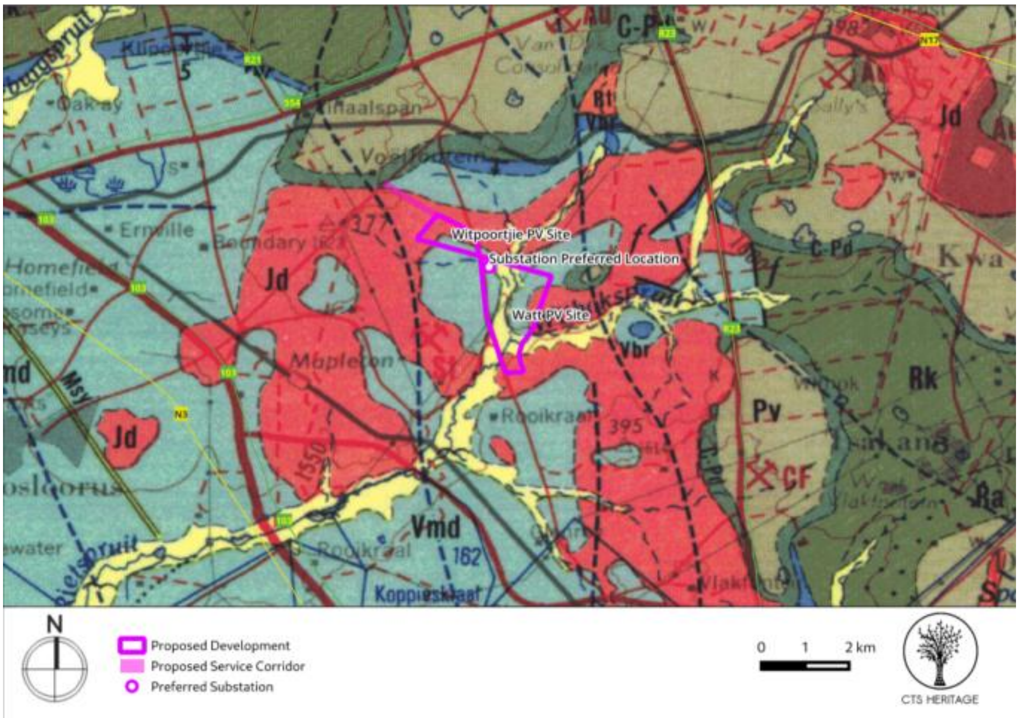

Figure 7-1 Geology Map of Proposed Development - Watt & Witpoortjie Solar PV Facility (Source: Palaeontology Impact Assessment)

In summary, the facility will have the following typical soil profile: -

> *"Extract from the CGS 2628 East Rand Map indicating that the development area for the REF development is underlain by sediments of Jd: Jurassic Dolerite as well as Vaalium Sedimentary and Volcanic Rocks Vmd: Malmani Dolomite, chert and Quaternary Sands. The development area is surrounded by Pv: Vryheid Sandstone, shale, coal beds, C-Pd: Dwyka diamictite, shale, as well as Rk: Basaltic Lava, agglomerate, tufrom the Klipriviersberg group."*

We note that the proposed development is located near areas containing Dolomitic ground and, therefore, requires confirmation from a Geotechnical Study. Consequently, we recommend a comprehensive geotechnical report to form part of the detailed design stage and refine the SWMP.

8. CLIMATE

8.1 Climate Classification[2]

Watt & Witpoortjie Solar PV facility and associated infrastructure are located ±8 km west of Brakpan in the Gauteng Province. According to the Klöppen-Geiger climate classification system, the province has a variety of climates, but it is predominantly dominated by warm temperate climates with dry winters (type 'Cwb').

8.2 Average Temperature[3]

The Average Maximum temperatures range between 5.5° and 26.6°C. January is the year's warmest month, with an average high temperature of 26.6°C. July is the coldest month of the year, with an average low temperature of 5.5°C. Refer to *Figure 8-1* below.

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[2] en-climate-data
[3] Weather Atlas

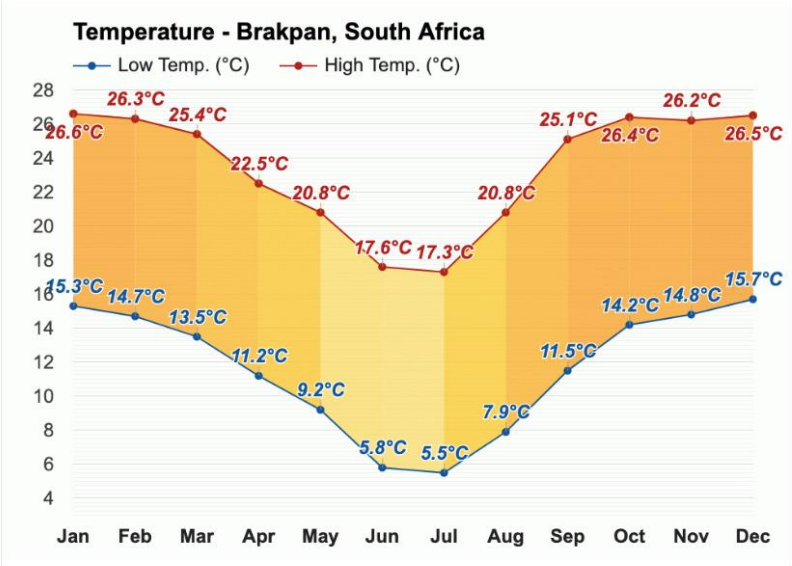

Figure 8-1 Average Temperature – Brakpan, South Africa

8.3 Mean Annual Precipitation (MAP)[4]

As mentioned in **Section 8.1** above, the Brakpan region has warm temperate climates with dry winters with an annual average rainfall of ±42-88 mm, mainly between October and March. January is, on average, the wettest month of the year, with ±88 mm accumulated for the month. The driest month with the least rainfall of ±1mm accumulated for the month is between June and August. Refer to *Figure 8-2* below.

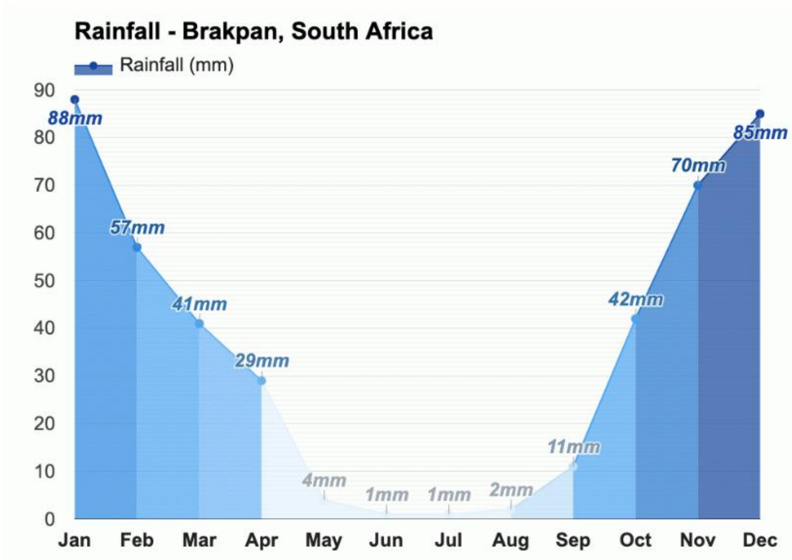

Figure 8-2 Average Rainfall – Brakpan, South Africa

The average rainfall days per annum is ±112.6 days, with January having the highest number of rainfall days (20 days). The month with the least rainfall days is June (0.9 days). Refer to *Figure 8-3* below.

[4] Weather Atlas

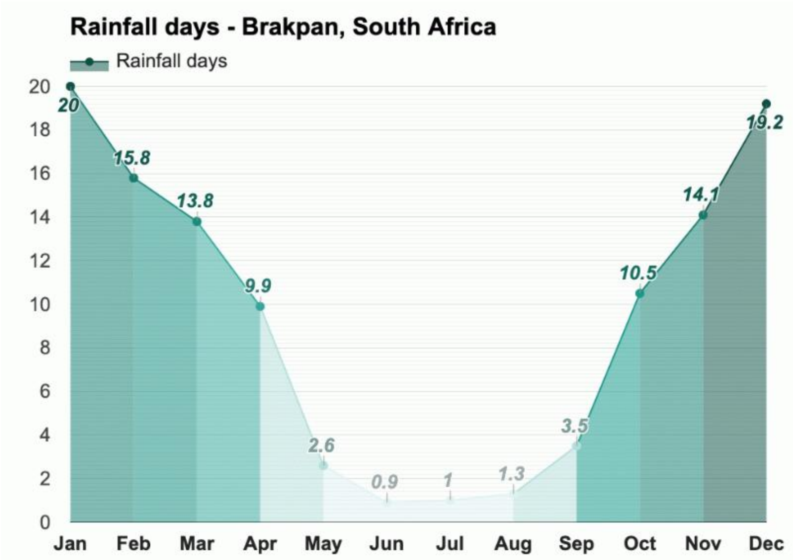

Figure 8-3 Average Rainfall Days – Brakpan, South Africa

8.4 Humidity[5]

The region's relative humidity ranges from a maximum of 69% in February to a minimum of 35% in September.

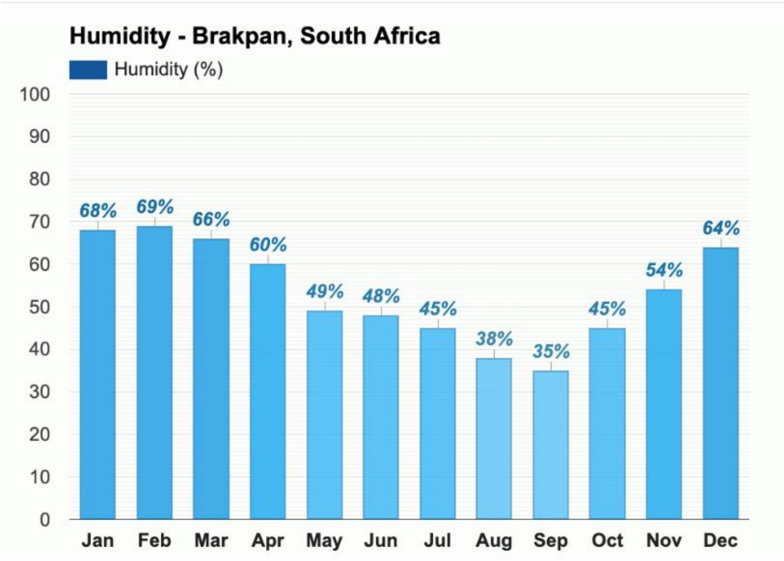

Figure 8-4 Average Relative Humidity – Brakpan, South Africa

8.5 Design Rainfall

Design Rainfall Estimation[6] software was used to obtain the rainfall data (tabulated below in **Table 8-1**) required for the run-off calculations.

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[5] Weather Atlas

[6] *Design Rainfall Estimation in South Africa Version 3* developed by MJ Gorven, JC Smithers and RE Schulze

Table 8-1 Watt & Witpoortjie Solar PV - Design Rainfall Data

Return Period		2yr	5yr	10yr	20yr	50yr	100yr	200yr
Duration		Rainfall Depth (mm)						
5	min	9.7	13.4	16.2	19.1	23.4	27.1	31.1
10	min	14.4	19.9	24	28.4	34.9	40.2	46.2
15	min	18.1	25	30.3	35.8	43.9	50.8	58.2
30	min	23	31.7	38.3	45.4	55.6	64.3	73.7
45	min	26.4	36.4	44	52.1	63.9	73.8	84.7
60	min	29.1	40.2	48.6	57.5	70.5	81.4	93.4
90	min	33.4	46.1	55.7	66	80.9	93.4	107.2
120	min	36.8	50.8	61.5	72.8	89.2	103	118.2
240	min	43.5	60	72.6	85.9	105.4	121.7	139.6
360	min	47.9	66.2	80	94.7	116.1	134.1	153.9
480	min	51.4	70.9	85.7	101.5	124.4	143.7	164.9
600	min	54.2	74.8	90.4	107	131.3	151.6	173.9
720	min	56.6	78.1	94.5	111.8	137.1	158.3	181.7
960	min	60.6	83.7	101.2	119.8	146.9	169.7	194.7
1200	min	64	88.3	106.8	126.4	155	179	205.4
1440	min	66.8	92.3	111.6	132	161.9	187	214.6
1	day	55.6	76.7	92.8	109.8	134.6	155.5	178.4
2	days	68.5	94.5	114.3	135.3	165.9	191.6	219.8
3	days	77.4	106.8	129.1	152.8	187.4	216.4	248.3
4	days	84.3	116.4	140.7	166.6	204.3	235.9	270.7
5	days	90.1	124.4	150.5	178.1	218.4	252.1	289.3
6	days	95.2	131.4	158.9	188.1	230.6	266.3	305.6
7	days	99.7	137.6	166.4	196.9	241.5	278.8	320

9. CATCHMENT - SURFACE HYDROLOGY

9.1 Drainage of Catchment

9.1.1 Primary Catchment

The site falls within the 'Vaal River' drainage catchment (Primary Catchment 'C'), covering an area of ±192 000 km². To the north, the Vaal River catchment extends through Johannesburg CBD; to the east, the Mpumalanga escarpment; to the south, the Lesotho border and Northern Cape provincial boundaries to the east, flowing westwards into the Orange River and ultimately towards the Atlantic Ocean. *Figure 9-1* below shows the primary catchments of South Africa.

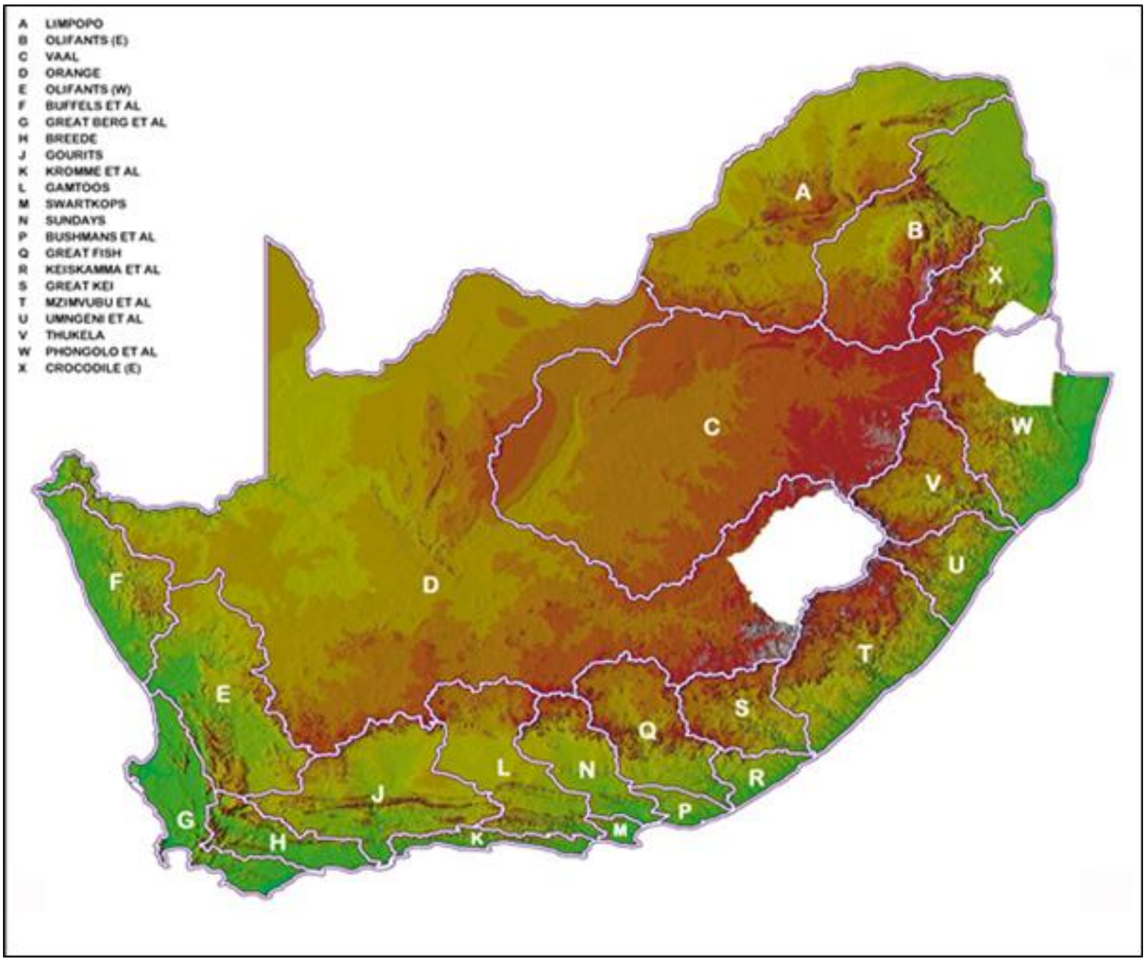

Figure 9-1 Department of Water and Sanitation (DWS) – Primary Catchments

9.1.2 Quaternary Catchment

The proposed facility is in Quaternary Catchment C22C. Catchment C22C forms part of the upper reaches of the Rietspruit, which ultimately flows into the Klip River and Vaal River, shown in *Figure 9-2* below. The Withok Spruit is a tributary of the Rietspruit with the confluence of the two occurring just below the development. The location of each major drainage line affecting the development is indicated on *Figure 9-3* while the analysis point for both the Rietspruit and the Withok Spruit is indicated in

Figure 9-4.

The catchment data for each respective analysis point is as follows.

Drainage Line	Catchment Area (km^2)	Length of Watercourse (km)	Elevation Difference (m)	Run Off Factor
Rietspruit	89.061	21.639	80.02	0.675
Withok Spruit	64.671	15.823	86.00	0.675

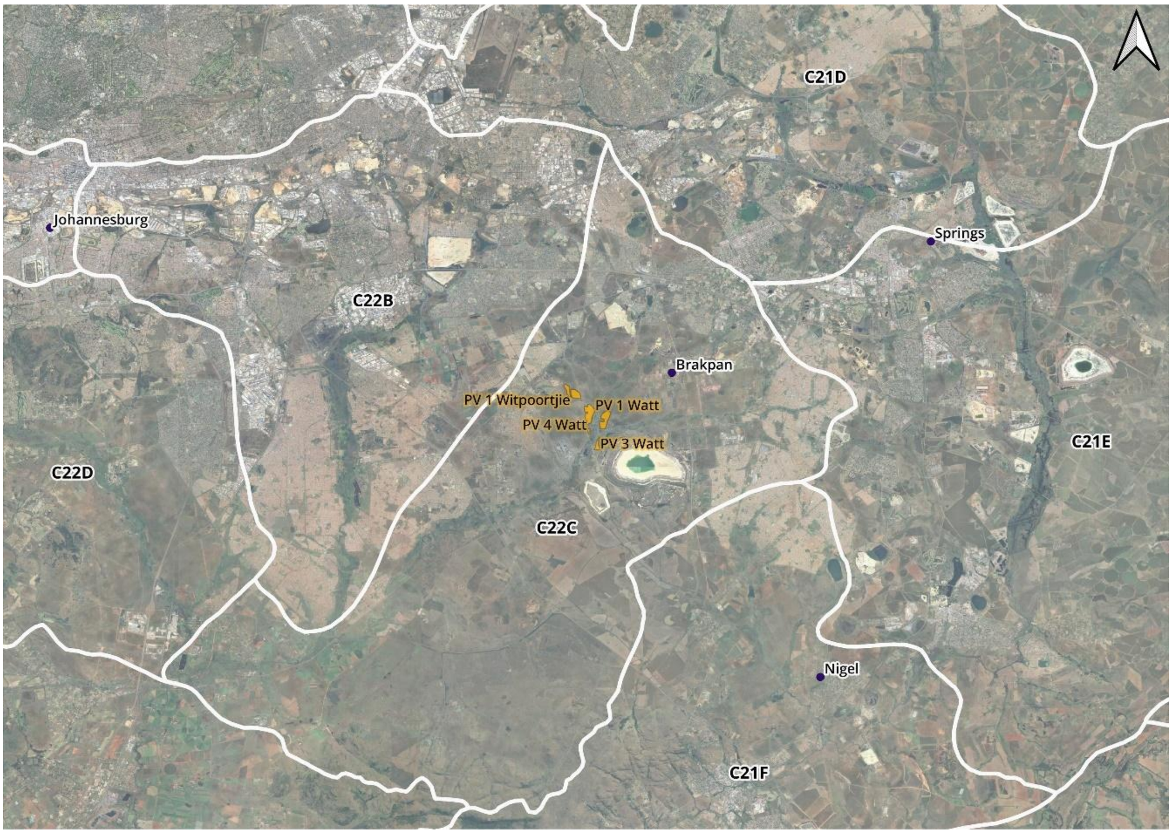

Figure 9-2 Department of Water and Sanitation (DWS) – Quaternary Catchments

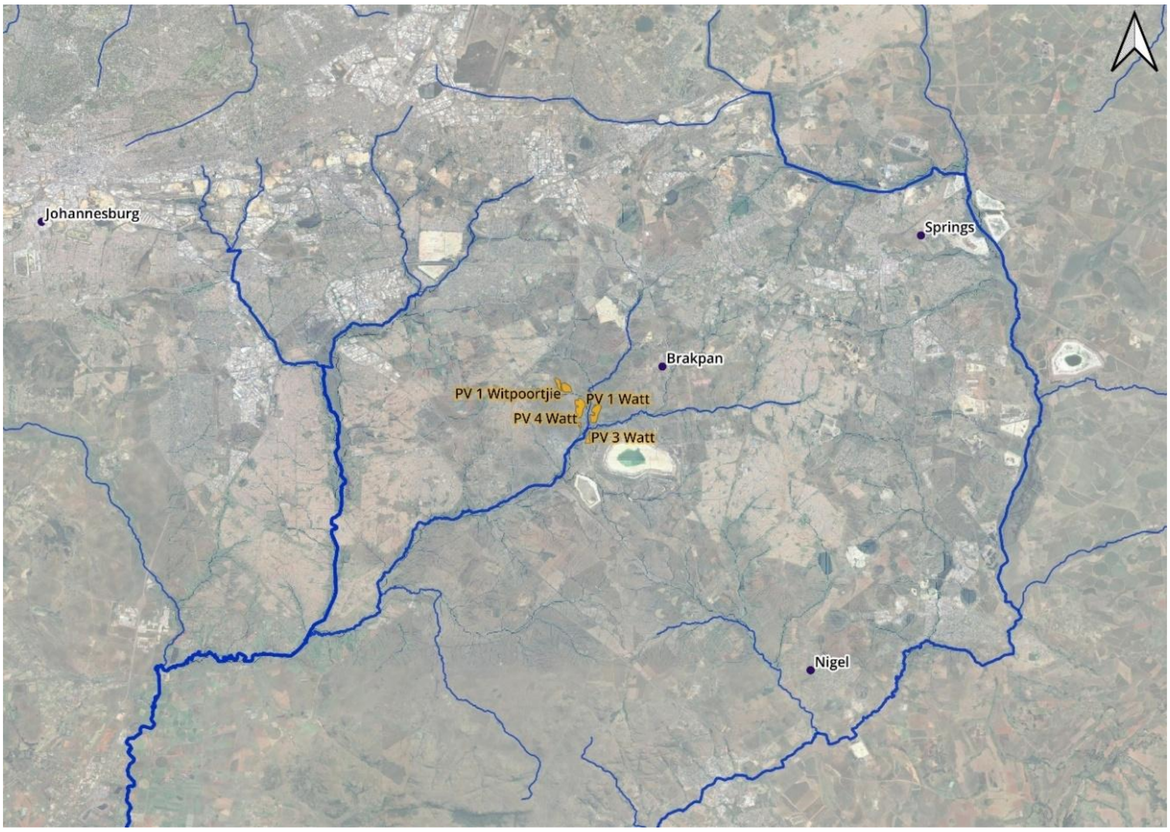

Figure 9-3 Larger Drainage Lines (Blue) outside the development

Figure 9-4 Rietspruit & Withok Spruit Analysation point

10. DEVELOPMENT - STORMWATER MANAGEMENT

10.1 Impact of Development[7]

Development is defined as the process of modification or evolution, which historically involves the improvement / construction of buildings and civil infrastructure. New development leads to an alteration in the hydraulic properties of the subjected area, changing surface run-off properties into pervious or impervious layers, subsequently increasing the surface run-off and altering inundation areas. Common historical stormwater infrastructure and surfaces are constructed to efficiently manage the run-off, resulting in shorter catchment response times and increased peak flows.

Stormwater management is key to reducing the negative impacts of the proposed development and keeping the receiving environment in its natural state. The management is achieved with adequate mitigation measures, per the applicable stormwater drainage standards and policies, to ensure the development can be accommodated within the receiving environment.

10.2 The Purpose of Stormwater Management[8]

The purpose of stormwater management is based on several aspects: health and safety, quality of life, and water conservation. These aspects are briefly described below:

- Directing and discharging stormwater allows the public to protect their health, welfare, and safety. It also protects property from flood hazards.
- Enhance the quality of life in communities that are affected.
- To grasp the opportunity to conserve water for beneficial public uses.
- To safeguard the natural environment.

[7] *Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology*
[8] *Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology*

- The balance of economic development and the necessity for a sustainable environment; and
- Optimum stormwater management methodologies are adopted so that the primary beneficiaries pay as per their possible gains.

10.3 Stormwater Management Policies & Design Guidelines

Urban Stormwater Management policies require that the post-development run-off from an area for storms of similar recurrence intervals may not exceed the run-off generated under the pre-development condition. For rural developments, the emphasis should be on the detrimental effect on the immediate environment concerning the control of water velocity and erosion rather than minor increases between the pre- and post-development flow volumes.

This study area falls within the City of Ekurhuleni, which adopts the same management, design guidelines, and standards. Therefore, we recommend that the stormwater drainage system, in principle, refers to the "Red Book[9]" and the "Drainage Manual[10]".

10.4 Stormwater Management Philosophy

The Stormwater Management Philosophy for the proposed development urges the developer, the professional teams, and contractors to achieve the following:

- Always maintain adequate ground cover in all areas to reduce the risk of erosion by wind, water and all forms of traffic.
- Prevent the concentration of stormwater flow at any point where the ground is susceptible to erosion. Where unavoidable, adequate protection of the ground must be provided.
- Reduce concentrated stormwater flows as much as possible by providing effective attenuation measures.
- Ensure the development does not increase the stormwater flow rate above what the natural ground can safely accommodate.
- Ensure that all stormwater control structures are constructed safely and aesthetically pleasing to keep up with the overall development.
- Prevent pollution of waterways and water features.
- Contain soil erosion by constructing protective works to trap sediment at appropriate locations. This protection applies particularly during construction, and
- Avoid situations where natural or artificial slopes become saturated and unstable during and after construction.

10.5 Stormwater Management Drainage System

Stormwater drainage systems can be considered dual systems incorporating minor and major storm return periods.

The minor stormwater drainage system caters for frequent storm events. Storms are minor in nature, usually including stormwater run-off with frequent return periods such as 2 years, 5 years, and/or 10 years.

The major stormwater drainage system caters to severe, infrequent storm events supported by the minor drainage system. Major storms include less frequent return periods, such as 20 years or more.

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[9] *Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology*
[10] *Drainage Manual 6th Edition, Published by The South African National Roads Agency SOC Ltd, 2013*

11. PRE-DEVELOPMENT RUN-OFF CHARACTERISTICS

11.1 Catchment Description

The development falls within five (5) minor catchment areas (Refer *Figure 11-3*), forming part of the one (1) quaternary catchment mentioned in **Section 9.** The development's catchment areas vary in size, ranging from 0.12 km^2 to 1.18 km^2 and are predominantly flat (~2.1%). The development catchment shows evidence of clearly defined watercourses with drainage lines occurring in multiple directions between the separate catchments.

The development is located in a rural area of the City of Ekurhuleni, Gauteng, where farming and mining occur. Referring to the SANBI Vegetation Map (2012), the vegetation in the area is described as 'Tsakane Clay Grassland' and features;

> *Flat, slightly undulating plains and low hills. Vegetation is short, dense grassland dominated by a mixture of common highveld grasses such as Themeda triandra, Heteropogon contortus, Elionurus muticus and a number of Eragrostis species. Most prominent forbs are of the families Asteraceae, Malvaceae, Lamiaceae and Fabaceae. Disturbances leads to an increase in the abundane of the grasses Hyparrhenia hirta and Eragrostic chloromelas.*

The proposed PV development is located between existing streams, rivers or floodplains. Therefore, the flood inundation of these areas will need to be determined at crossings and where infrastructure encroaches on the inundation areas.

11.2 Site Topography

Extensive, irregular plains cover the area on a slightly sloping plateau. All developments are located on natural drainage lines which drain towards the Rietspruit. The Rietspruit ultimately drains into the Vaal River. (Refer to *Figure 9-3* above).

When 'Revision 0' was compiled, detailed contour data for the broader study area were unavailable. Therefore, the 30m DSM from ALOS World 3D was sourced to provide terrain data for this area.

A contour surface was generated from the Digital Surface Model (DEM) at 2.5 m intervals using QGIS. We recommend that an updated and detailed SWMP be completed at the Detailed Design stage for SDP purposes.

From *Figure 11-1* and *Figure 11-2* below, we confirm a natural slope of less than 3% for catchment areas forming part of the development with the following percentages:

- Wetlands & Pans (<3%) – 95%
- Flat Areas (3% to 10% slope) – 5%
- Hilly Areas (10% to 30% slope) – 0%
- Steep Areas (>30% slope) – 0%

11.3 Site Vegetation

The vegetation in the area is made up of plains dominated by highveld grasses.

Figure 11-1 Current Site Vegetation (Sept 2021)

Figure 11-2 Typical Drainage Lines (Sept 2021)

Figure 11-1 and *Figure 11-2* indicate the typical ground cover on the site, with the following percentage splits applicable: -

- Thick Bush & Plantations – 0%
- Light Bush & Farmlands – 0%
- Grasslands – 100%
- No Vegetation – 0%

11.4 Geotechnical Conditions

Concerning **Section 7** – **Geotechnical Study** above, soil conditions have been assumed as follows: -

- Very Permeable – 0%
- Permeable – 90%
- Semi-permeable – 10%
- Impermeable – 0%

11.5 Hardstand Areas

The property currently has no areas of hardstand: -

- Hardstand Areas – 0%

11.6 Run-Off Coefficient

Based on *Table 3C.1* of the *Drainage Manual – 6th Edition*[11], the following run-off coefficients have been assigned for this calculation: -

Table 11-1 Pre-Development Run-Off Coefficient

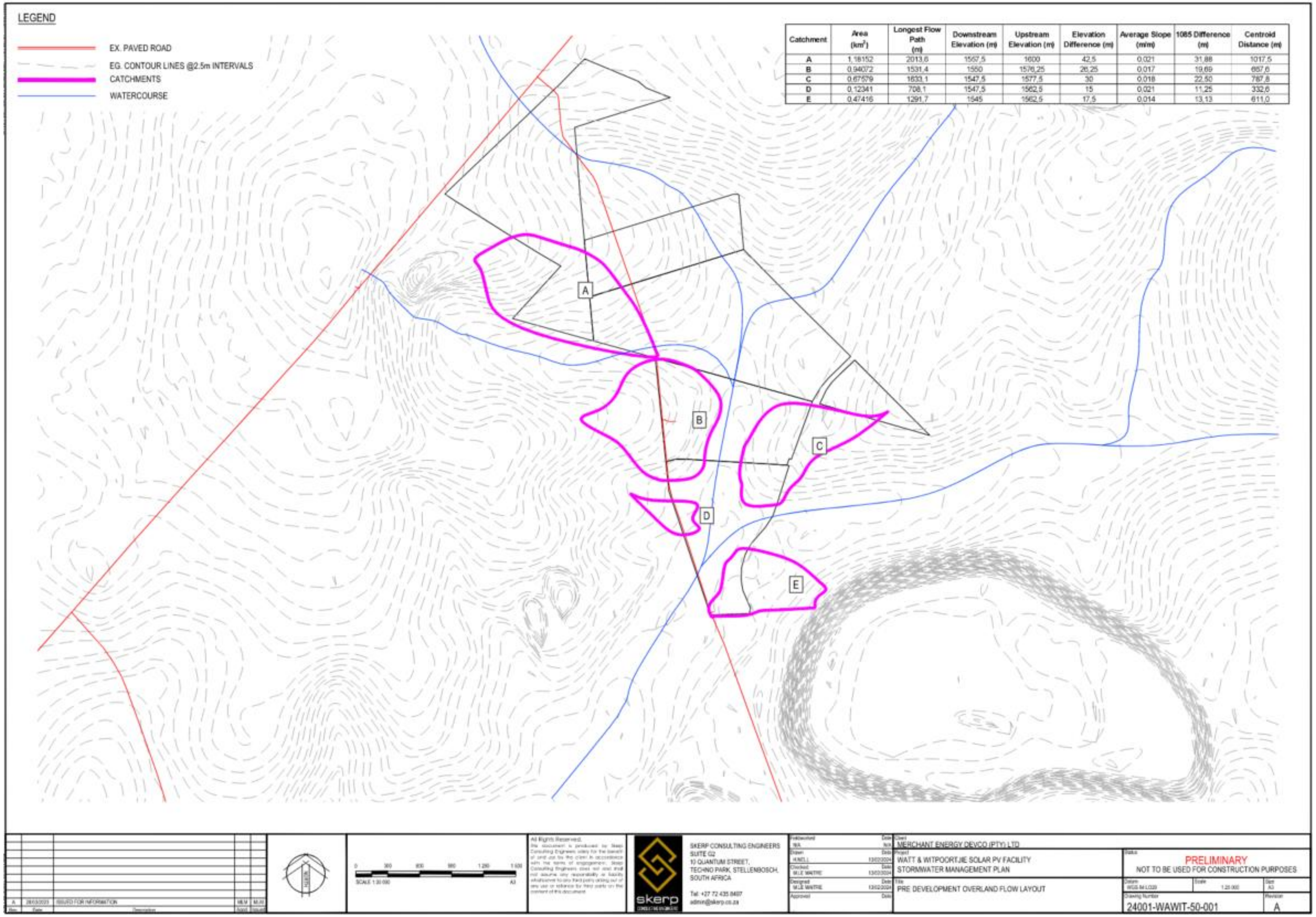
Surface Slope - Wetlands & Pans	**0.03**	**95.0%**	0.029
Surface Slope - Flat Areas (3-10%)	**0.08**	**5.0%**	0.004
Surface Slope - Hilly Areas (10-30%)	**0.16**	**0.0%**	0.000
Surface Slope - Steep Areas (>30%)	**0.26**	**0.0%**	0.000
Soil - Very Permeable	**0.04**	**0.0%**	0.000
Soil - Permeable	**0.08**	**90.0%**	0.072
Soil - Semi-Permeable	**0.16**	**10.0%**	0.016
Soil - Impermeable	**0.26**	**0.0%**	0.000
Vegetation - Thick Bush/Plantations	**0.04**	**0.0%**	0.000
Vegetation - Light Bush/Farm Lands	**0.11**	**0.0%**	0.000
Vegetation - Grasslands	**0.21**	**100.0%**	0.210
Vegetation - No Vegetation	**0.28**	**0.0%**	0.000
			0.331

Based on the preceding table, we calculated a **PRE-DEVELOPMENT Run-Off Coefficient** of **0.331**.

It should also be noted that no 'Area Reduction Factor' has been applied as we believe the drainage catchment areas are too small.

[11] *Drainage Manual 6th Edition, Published by The South African National Roads Agency SOC Ltd, 2013*

Figure 11-3 Watt & Witpoortjie Solar PV Facility– Pre-Development Overland Flow



Catchment	Area (km^2)	Longest Flow Path (m)	Downstream Elevation (m)	Upstream Elevation (m)	Elevation Difference (m)	Average Slope (m/m)	1085 Difference (m)	Centroid Distance (m)
A	1,18152	2013,6	1567,5	1600	42,5	0,021	31,88	1017,5
B	0,94072	1531,4	1550	1576,25	26,25	0,017	19,69	667,6
C	0,67579	1633,1	1547,5	1577,5	30	0,018	22,50	787,8
D	0,12341	708,1	1547,5	1562,5	15	0,021	11,25	332,6
E	0,47416	1291,7	1545	1562,5	17,5	0,014	13,13	611,0

12. POST-DEVELOPMENT RUN-OFF CHARACTERISTICS

12.1 Site Development Plan (SDP)

Concerning the SDP, the proposed Watt & Witpoortjie Solar PV Facility layout will consist of 103.33ha of PV arrays, an access road, internal roads, a substation, a battery energy storage system (BESS), laydown areas, auxiliary buildings, and external buildings, etc. The total development area will cover a combined area of ±626.03 ha. In contrast, Watt Solar PV Facility's permanent footprint only covers ±77 ha, Witpoortjie Solar PV Facility covers ±29 ha. The shared facilities add another 9ha.

In determining the post-development characteristics of a PV development, we refer to the study completed to understand the hydrological response of PV developments (Cook et al., 2013)[12]. The study found that introducing PV panels to an area did not significantly affect the runoff volumes, peaks, or time to peaks when the grass beneath the panels is kept in place and maintained well.

12.2 Site Topography

Bulk platforms, roads, and buildings will be constructed at slopes less steep than the natural topography.

The following percentage splits are applicable: -

- Wetlands & Pans (<3%) – 95%
- Flat Areas (3% to 10% slope) – 5%
- Hilly Areas (10% to 30% slope) – 0%
- Steep Areas (>30% slope) – 0%

12.3 Geotechnical Conditions

Concerning **Section 7 – Geotechnical Study**, it has been assumed that the percentages used in the 'pre-development' run-off coefficient will remain unchanged for the 'post-development' as the facility would have little or no effect on the existing ground conditions.

The following percentages will be used: -

- Very Permeable – 0%
- Permeable – 90%
- Semi-permeable – 10%
- Impermeable – 0%

12.4 Developed Components

Once developed, it has been confirmed that the property will have no significant impervious surfaces in the form of surfaced roads or buildings other than the natural ground cover. However, gravel roads and platforms will be constructed across the site to provide access to the PV arrays. Gravel roads will have frequent discharge points to reduce stormwater concentrations and ultimately minimise the development impact.

A slight increase in the area of imperviousness is therefore assumed:-

- Gravel Roads & Platforms – 0%
- PV Facility – 49%
- Grasslands – 50%
- No Vegetation – 0%

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[12] Cook, LM and McCuen, RH (2013) '*Hydrological Response of Solar Farms'*

12.5 Run-Off Coefficient

Based on *Table 3C.1* of the *Drainage Manual – 6th Edition*[13], the following run-off coefficients percentages have been assigned for this calculation: -

Table 12-1 Post-Development Run-Off Coefficient

UN-DEVELOPED COMPONENT : Run-off Percentages			
Surface Slope - Wetlands & Pans	**0.03**	**95.0%**	0.029
Surface Slope - Flat Areas (3-10%)	**0.08**	**5.0%**	0.004
Surface Slope - Hilly Areas (10-30%)	**0.16**	**0.0%**	0.000
Surface Slope - Steep Areas (>30%)	**0.26**	**0.0%**	0.000
Soil - Very Permeable	**0.04**	**0.0%**	0.000
Soil - Permeable	**0.08**	**90.0%**	0.072
Soil - Semi-Permeable	**0.16**	**10.0%**	0.016
Soil - Impermeable	**0.26**	**0.0%**	0.000
Vegetation - Thick Bush/Plantations	**0.04**	**0.0%**	0.000
Vegetation - Light Bush/Farm Lands	**0.11**	**0.0%**	0.000
Vegetation - Grasslands	**0.21**	**100.0%**	0.210
Vegetation - No Vegetation	**0.28**	**0.0%**	0.000
			0.331
DEVELOPED COMPONENT: Run-off Percentages			
Surface Slope - Wetlands & Pans	**0.03**	**95.0%**	0.029
Surface Slope - Flat Areas (3-10%)	**0.08**	**5.0%**	0.004
Surface Slope - Hilly Areas (10-30%)	**0.16**	**0.0%**	0.000
Surface Slope - Steep Areas (>30%)	**0.26**	**0.0%**	0.000
Soil - Very Permeable	**0.04**	**0.0%**	0.000
Soil - Permeable	**0.08**	**90.0%**	0.072
Soil - Semi-Permeable	**0.16**	**10.0%**	0.016
Soil - Impermeable	**0.26**	**0.0%**	0.000
Gravel Roads & Platforms	**0.5**	**1.0%**	0.005
PV Facilities	**0.22**	**49.0%**	0.108
Vegetation - Grasslands	**0.21**	**50.0%**	0.105
Vegetation - No Vegetation	**0.28**	**0.0%**	0.000
			0.338

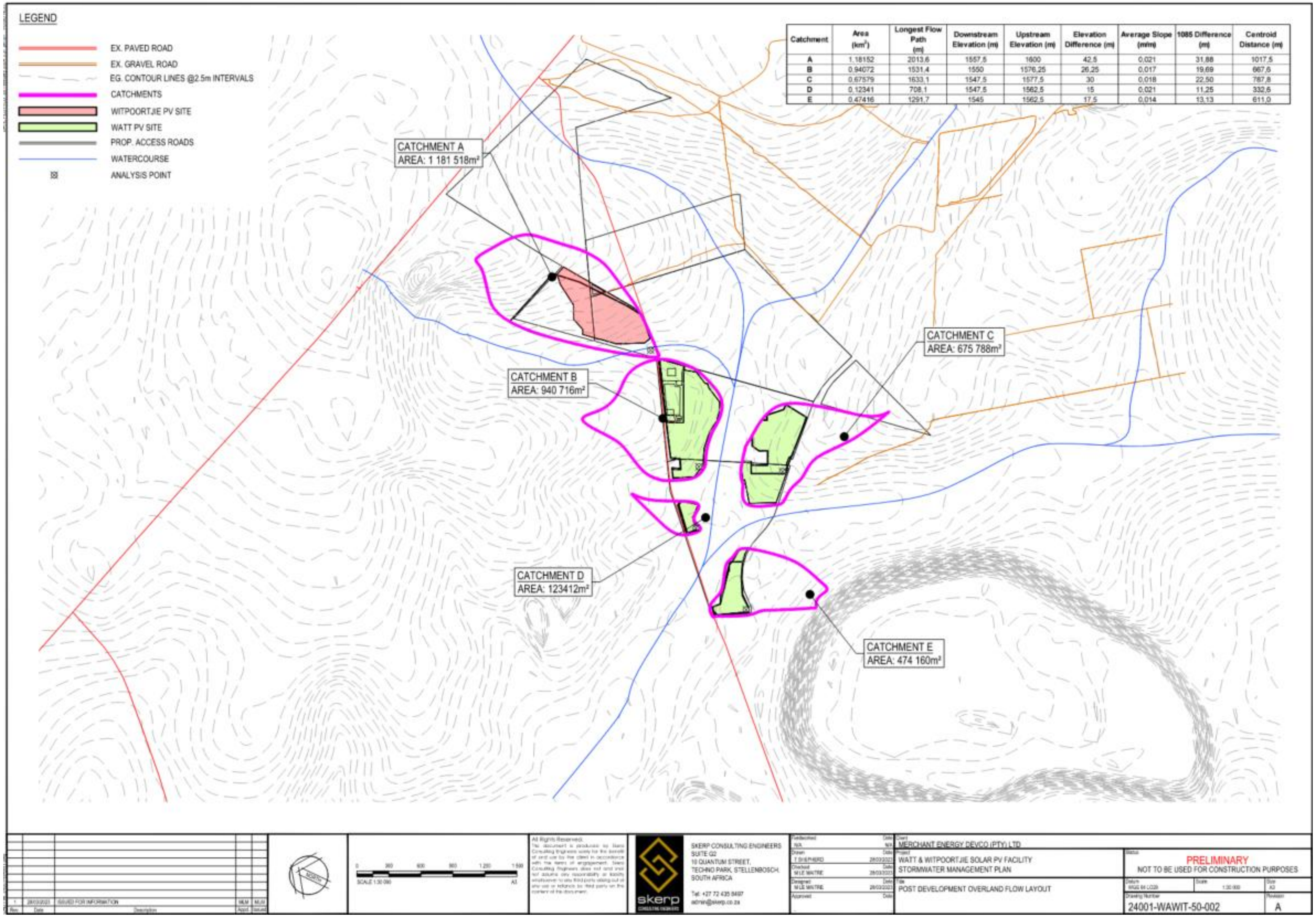
RUN-OFF COEFFICIENT: **With DOLOMITE**		Q2	Q5	Q10	Q25	Q50	Q100	Q200
Precentage **UN-DEVELOPED**	50.0%	0.083	0.091	0.099	0.111	0.137	0.165	0.165
Percentage **DEVELOPED**	50.0%	0.085	0.091	0.099	0.111	0.137	0.165	0.169
TOTAL Run-Off coefficient		**0.167**	**0.182**	**0.198**	**0.221**	**0.274**	**0.331**	**0.334**

RUN-OFF COEFFICIENT: **With DOLOMITE**		Q2	Q5	Q10	Q25	Q50	Q100	Q200
Precentage **UN-DEVELOPED**	75.0%	0.124	0.136	0.149	0.166	0.206	0.248	0.248
Percentage **DEVELOPED**	25.0%	0.042	0.045	0.050	0.055	0.069	0.083	0.085
TOTAL Run-Off coefficient		**0.166**	**0.182**	**0.198**	**0.221**	**0.274**	**0.331**	**0.332**

Based on the preceding table, we calculated a factored **POST-DEVELOPMENT Run-Off Coefficient** for each permutation, one with 50% of the catchment area developed and another with 25%**.**

[13] *Drainage Manual 6th Edition, Published by The South African National Roads Agency SOC Ltd, 2013*

Figure 12-1 Watt & Witpoortjie Solar PV Facility – Post-Development Overland Flow



Catchment	Area (km²)	Longest Flow Path (m)	Downstream Elevation (m)	Upstream Elevation (m)	Elevation Difference (m)	Average Slope (m/m)	1085 Difference (m)	Centroid Distance (m)
A	1.18152	2013,6	1557,5	1600	42,5	0,021	31,88	1017,5
B	0.94072	1531,4	1550	1576,25	26,25	0,017	19,69	667,6
C	0.67579	1633,1	1547,5	1577,5	30	0,018	22,50	787,8
D	0.12341	708,1	1547,5	1562,5	15	0,021	11,25	332,6
E	0.47416	1291,7	1545	1562,5	17,5	0,014	13,13	611,0

13. SURFACE MODELLING

13.1 Modelling Selection – Development

Empirical and Statistical Methods were not considered for calculating the development area's stormwater generation as insufficient hydrological records and observed points were available. Therefore, a deterministic method has been selected to determine the development's results.

This method comprises mainly manual, graphic and computer-generated spreadsheets. Therefore, we believe our selection of the 'Unit Hydrograph Method' (HRU 1972) is appropriate because the site does not have a varying degree of post-development land change and does not have any existing permanent dams and sub-catchments. Computerised spreadsheets have been used to assist with iterations and to eliminate manual calculation errors.

As noted in **Section 11**, the proposed site is affected by five (5) minor catchments. **Section 13.1.1** below modelled the surface run-off for each catchment for Pre (*Table 13-1*) and Post-Development (*Table 13-2*) conditions.

13.1.1 Development - Surface Run-Off Modelling Results

Table 13-1 Pre-Development Modelling Peak Flow (m^3/s)

Catchment	Return Period					
	100	50	25	10	5	2
A	17.07	12.30	8.42	5.75	4.03	1.37
B	11.27	7.71	5.00	3.22	2.13	1.07
C	10.82	7.79	5.33	3.64	2.55	0.91
D	2.88	2.07	1.42	0.97	0.68	0.30
E	8.23	5.93	4.06	2.77	1.94	0.73

Table 13-2 Post-Development Modelling Peak Flow (m^3/s)

Catchment	Return Period					
	100	50	25	10	5	2
A	17.07	12.30	8.42	5.75	4.03	1.37
B	11.27	7.71	5.00	3.22	2.13	1.09
C	10.82	7.79	5.33	3.64	2.55	0.91
D	2.88	2.07	1.42	0.97	0.68	0.30
E	8.23	5.93	4.06	2.77	1.94	0.73

The results above indicate that the proposed development will have little to no effect on the pre- and post-development flows. Therefore, we believe implementing minor localised stormwater management guidelines can accommodate the proposed development without negatively impacting the downstream catchment.

13.2 Modeling Selection – Catchment

Statistical Methods were excluded from calculating the quaternary catchments, while Empirical Methods were included.

The Rational Method was selected based on the drainage line having a defined watercourse.

13.2.1 Catchment – Surface Modeling Results

Table 13-3 Catchment Modeling Peak Flow (m^3/s)

Drainage Line	Return Period					
	100	**50**	**25**	**10**	**5**	**2**
Rietspruit	438.6	380.7	304.1	246.1	188.2	111.5
Withok Spruit	396.9	344.4	275.1	222.7	170.2	100.9

The results above were included in a two-dimensional (2D) model simulation with a Manning's roughness coefficient of 0.6 bisecting the development.

Figure 13-1 below is a plan showing the difference in depths between the pre- and post-development inundation areas where the PV3 access road is located. The level difference mainly occurs at the access road crossing, where the road acts as a weir rather than an obstruction, and the velocity over the obstruction increases from an average of 1.0m/s to 1.3m/s to overcome the obstruction.

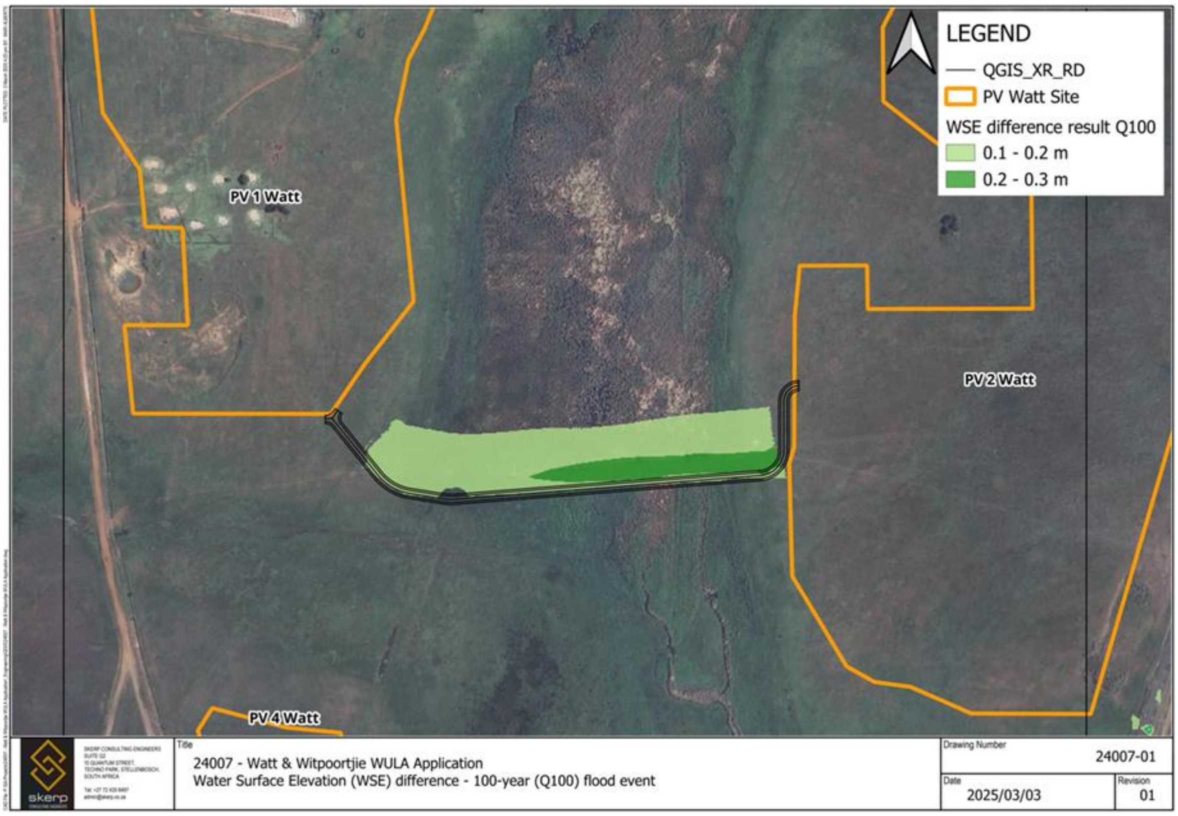
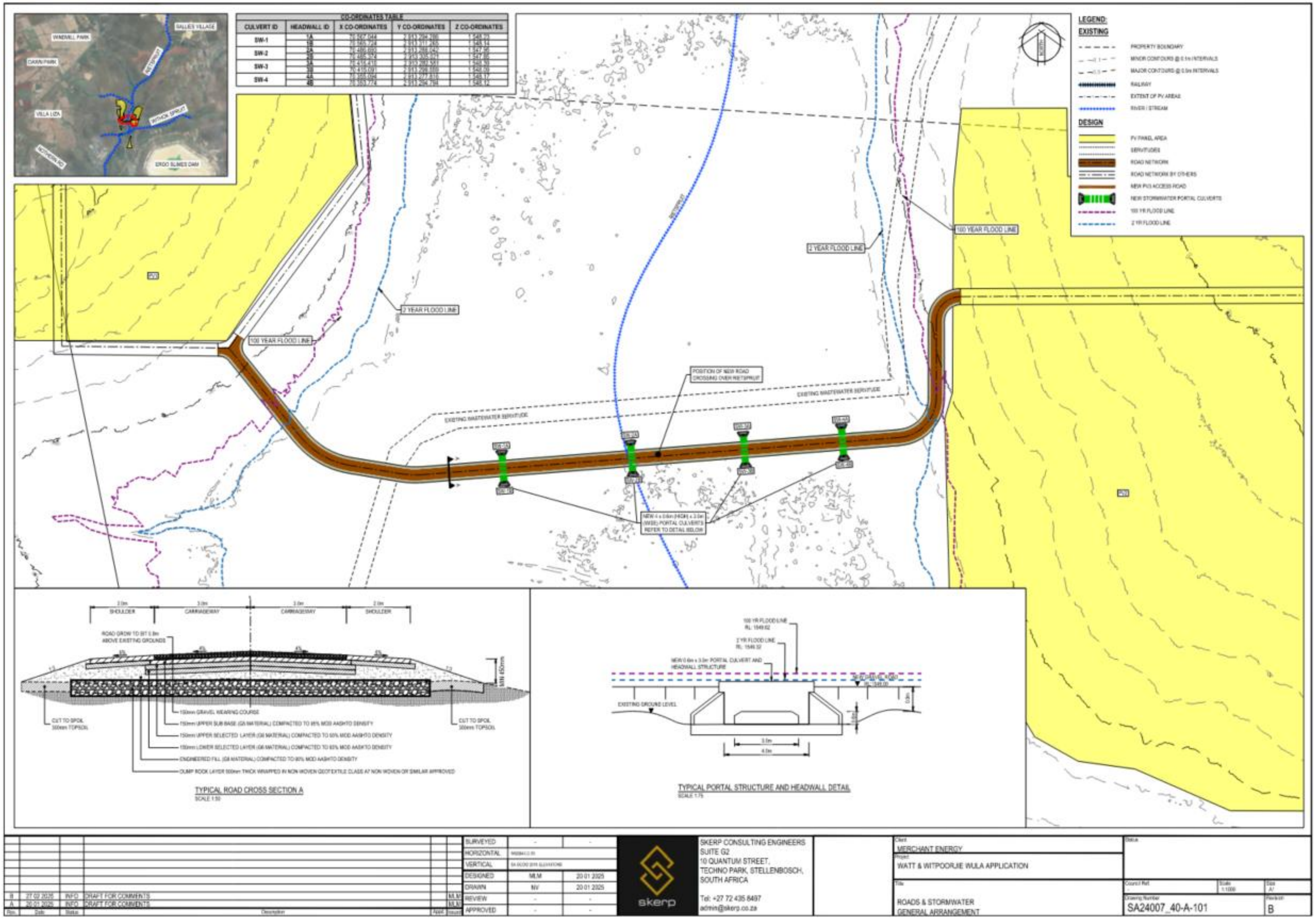


Figure 13-1 PV3 Access Road - Pre & Post Development Level difference

Proposed design of the PV3 access road is included below in *Figure 13-2*.

Figure 13-2 Proposed PV3 Access Road



14. STORMWATER MANAGEMENT & GUIDELINES

The buildings and structures within the development will require the management of stormwater runoff in accordance with the local authority or municipality's stormwater management philosophy and policies. As these guidelines are specific to particular areas of the proposed development, which will only be confirmed at the SDP (Site Development Plan) stage, the following guidelines aim to assist in the design of both major and minor stormwater infrastructure, ensuring that the objectives of this SWMP are met during the planning, design, construction, and operational phases of the development.

14.1 Buildings

Any building will inevitably result in some degree of flow concentration or deflection around buildings. The developer / owner shall ensure that all stormwater flow paths are protected against erosion.

Any inlet to a piped system shall be fitted with a screen / grating to prevent debris and refuse from entering the stormwater system. This must be installed immediately upon the infrastructure's installation. The owner/developer is responsible for maintaining the screen/grating to ensure smooth flow.

No building works, earthworks, walls, or fences may obstruct or encroach on a watercourse inside or outside the site without approved plans that do not compromise the objectives of the SWMP and any required Authority approvals.

14.2 Roof Drainage

Building designs must ensure that rainfall run-off from roofing and other areas, not subjected to excessive pollution, can be efficiently captured for re-use for on-site irrigation and non-potable water uses.

Where storage for re-use and ground conditions permit, rainwater run-off should connect to rainwater and stormwater tanks (Refer to *Figure* 14-1 for example) or detention areas to maximise groundwater recharge. These detention areas must be designed to attenuate run-off, specifically, the peak flows experienced in the reaches of a watercourse.

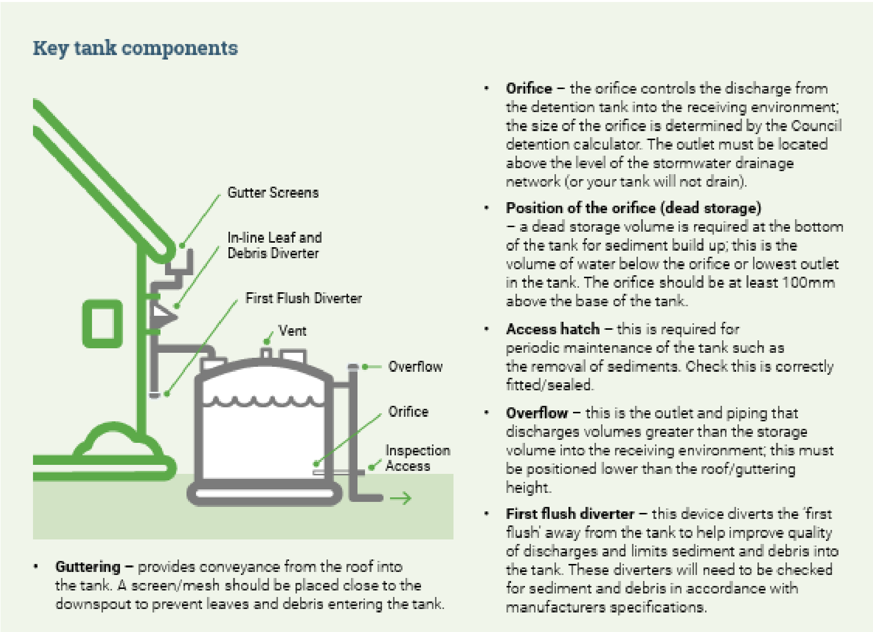


Figure 14-1 Typical Rainwater & Stormwater Tank[14]

[14] Central Hawkes Bay District Council – *Stormwater Management Practice Note: SW01*

14.3 Parking and Paved Areas

Parking or paved areas should be designed to attenuate stormwater run-off to an acceptable degree by allowing ponding or infiltration. Stormwater from such areas must be discharged and controlled as overland sheet flow or larger attenuation facilities.

14.4 Roads

Roads should be designed and graded to avoid the concentration of flow along and off the road (*Figure 14-2*). Regular side drains discharge points along roads for overland flow to continue as sheet flow towards drainage lines per pre-development conditions (Refer *Figure 11-3*). Where flow concentration is unavoidable, measures should be taken to incorporate the road into the major stormwater system, providing appropriately designed attenuation storage facilities at suitable points.

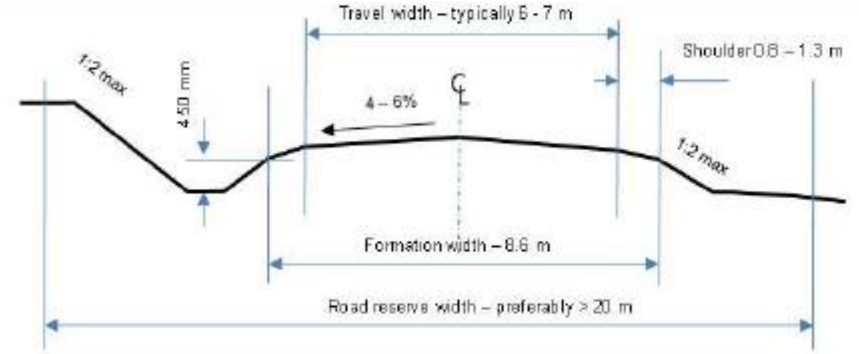


Figure 14-2 Typical Road Cross Section showing side drains

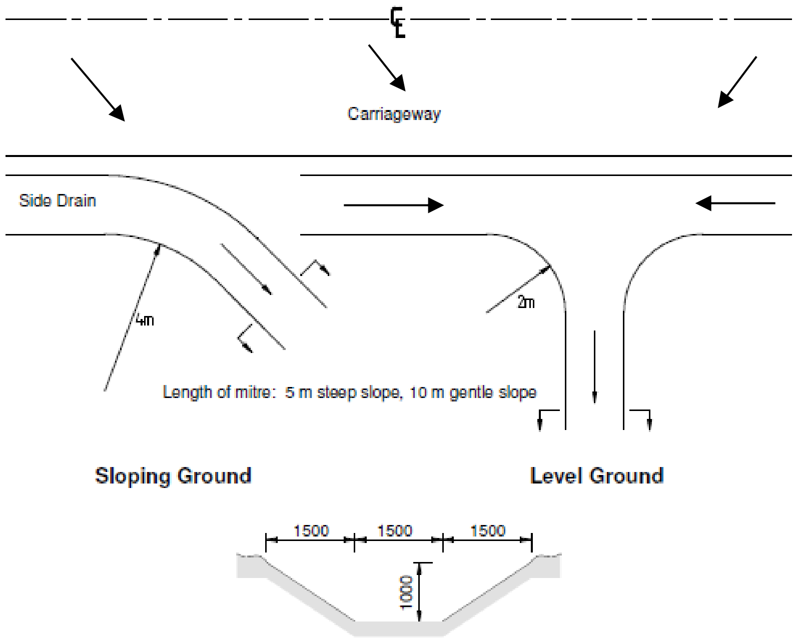


Figure 14-3 Typical Stormwater Mitre Drain / Channel

Gravel roads crossing drainage lines require a suitable-sized culvert, concrete causeways (*Figure 14-5*), or cut-off walls (*Figure 14-4*) to ensure vehicles can safely pass over natural drainage lines. Culverts for roads must be designed to ensure that the capacity of the culvert does not exceed the pre-development stormwater flow at that point. They can also assist in providing minor attenuation storage on the upstream side of the road crossing.

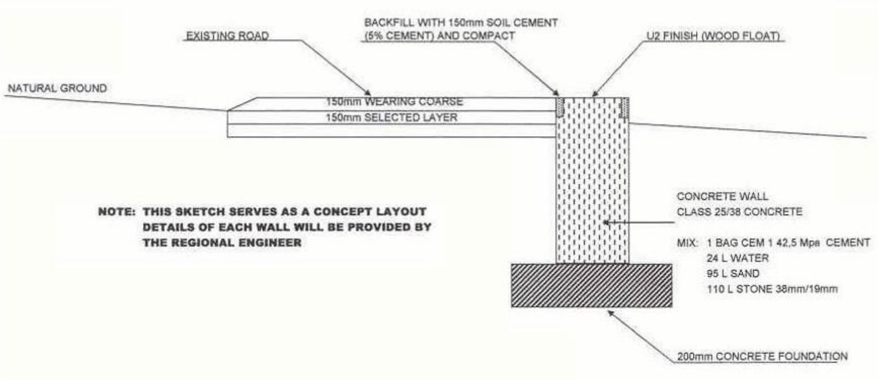


Figure 14-4 Typical Detail of a Cut-Off wall

Figure 14-5 Typical Low-Level Concrete Structure

Outlet and culvert discharge points into the natural watercourse must be designed to dissipate flow energy and any unlined downstream channel must be adequately protected against soil erosion. (Refer *Figure 14-6*)

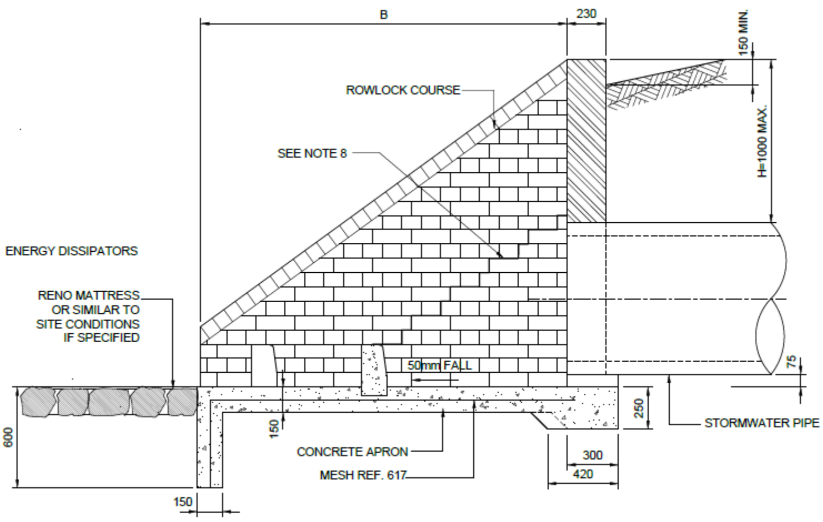


Figure 14-6 Typical Stormwater Headwall with Energy Dissipators

14.5 Subsurface Disposal of Stormwater

Any construction providing for the subsurface disposal of stormwater should be designed to ensure that such disposal does not cause slope instability or areas of concentrated saturation or inundation. Infiltration structures should be integrated into the terrain to be unobtrusive and in keeping with the natural surroundings.

14.6 Channels

Channels may be constructed to convey stormwater directly to a natural watercourse where necessary and unavoidable. The channels must be suitably lined to prevent erosion / scour and provide maximum possible energy dissipation of the flow. Such linings can vary from vegetated earthen to stone pitching or reinforced concrete.

14.7 Energy Dissipation

Measures should be taken to dissipate flow energy wherever concentrated stormwater flow is discharged onto the natural ground.

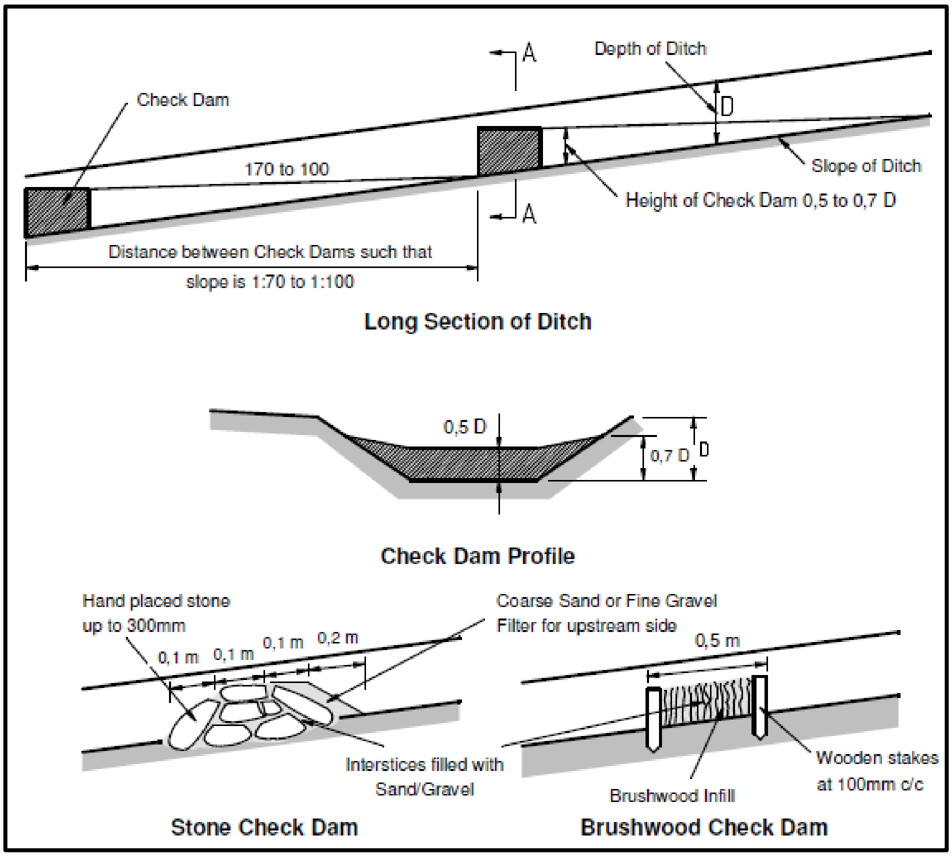


Figure 14-7 Typical Erosion Control

14.8 Open Trenches

Open trenches should not be left open and unprotected for extended periods and should be progressively backfilled as construction proceeds. Excavated material to be used as a backfill must be placed close to the trench on the upstream side to avoid loose material from washing away.

14.9 Stockpiles

Material is to be stockpiled away from drainage paths. Loose material such as stone, sand or gravel must be covered or kept damp to minimise dust. Temporary silt screens are to be positioned immediately downstream of stockpiles to intercept loose material which may be washed away.

14.10 Stormwater Pollution Control

For the orientation of panels, we recommend that the drainage pattern, flow concentration, drainage area, and velocities be considered at the detailed design stage. Rows perpendicular to the contours may result in higher run-off concentrations; therefore, mitigation measures are to be included to optimise orientation and keep the run-off as sheet flow across the entire site.

PV panels shall be designed and constructed in such a manner to allow for vegetative growth and maintenance beneath and between the panels. Although not applicable to this development, if any of the PV modules / strings are greater than 3 m high, from the lowest vertical clearance of the panels to above the ground. In that case, non-vegetative control measures will be required to prevent / control erosion and scour along the drip line or otherwise provide energy dissipation from the water running off the panels.

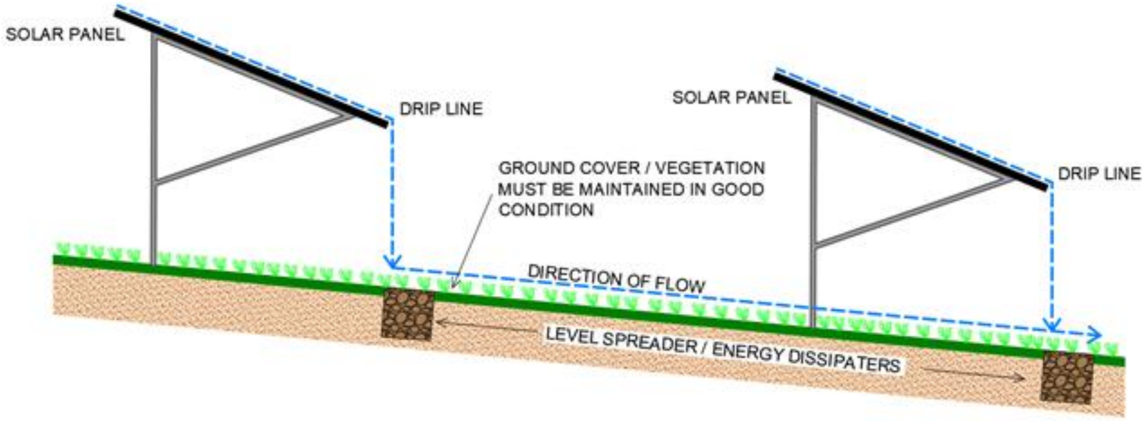


Figure 14-8 Stormwater control of Fixed Tilt PV showing drip line (Conceptual)

15. STORMWATER MANAGEMENT POLICY

The following rules are to be observed by the owner, developer, professional team, contractors, and sub-contractors:

- The Environmental Management Program (EMPr), as per the EIA and approved by the competent authority, will manage stormwater run-off during construction. All construction activities within the development must comply with the EMPr. This SWMP document is supplementary to the EMPr. The control measures herein are not considered all-encompassing, as the contractor will have to adapt site-specific control measures.
- Before the commencement of any construction activities, the contractor must compile and submit his construction SWMP, which needs to comply with the approved EMPr. The plan must include measures to control and prevent erosion during and after construction.
- Existing flood lines / wetlands / stormwater attenuation areas should be protected from encroachment by the development.
- Development designs must include measures for attenuating the increased concentration of stormwater run-off. The post-development peak flows can be attenuated to pre-development conditions if adequate stormwater mitigation measures are not implemented.
- On-site stormwater control systems, such as swales, berms and attenuation ponds, must be constructed before any other construction commences. These systems must be monitored and appropriately adjusted as construction progresses to ensure complete stormwater, erosion and pollution control.
- All formed embankments must be adequately stabilised.

- An approved landscaping and re-vegetation plan must be implemented immediately after building works have reached a stage where newly established ground cover is not at risk from the construction works.
- The contractor must show that this document's provisions, regulations and guidelines have been considered.
- In the event of a failure to adequately implement the approved SWMP, the contractor shall be responsible for all consequential damage at his own cost. The developer is therefore advised to ensure that all members of the professional team and contractors are competent to undertake the development work and are adequately insured.
- Appropriately designed attenuation / detention facilities will be located at appropriately selected sites based on geotechnical, environmental and topographical conditions, including wetland conservation.
- Where conditions permit, open ditches, drains and channels will be used instead of pipes. On steeper slopes, where high flow velocities are anticipated, appropriate linings for all channels must be provided to withstand erosion. Such linings will vary from vegetated earthen to stone pitching and reinforced concrete.
- Flow velocities must be reduced wherever possible to reduce the erosion potential in channels and points of flow concentration (typically at outlets).
- Silt, trash and oil traps must be strategically provided to ensure water quality is not compromised and prevent drainage system blockages.
- Areas within the proposed development that are bound on stormwater attenuation areas, near road crossings, watercourse confluences and water features might be subject to flooding. In these situations, all development should take place above the outfall levels with an appropriate freeboard allowance.
- Potential future development in these sub-catchments should be considered, and any stormwater attenuation requirements should be identified for areas flowing into the development area. Likewise, consideration must be given to the stormwater flowing out of the development, which may impact the downstream areas and watercourses. Appropriate measures must be taken to ensure any upstream development does not result in an increased flood damage risk downstream; and
- All-natural and unlined channels should be inspected for adequate soil binding by sustainable ground cover. Stone pitching should be used to reinforce channel inverts on steep slopes.

16. CONCLUSION & IMPACT STATEMENT

- In conclusion;
    - The Surface Modelling (**Section 13**) reveals that the proposed development / infrastructure will have a minimal impact on the stormwater quality and quantities of post-development stormwater flow (operational phase).
    - The highest impact will, in all likelihood, occur during the construction phase, and these impacts must be strictly managed under the advisement of the guidelines set out in this document.
    - The need for formal stormwater interventions can be minimised if the development is designed to maintain the existing drainage patterns. Overland flow via poorly-defined drainage paths will be the primary form of conveyance.
    - The civil engineers must prepare a detailed stormwater management plan for construction purposes during the detailed design stage, describing and illustrating the proposed stormwater and erosion control measures.
    - We note that the proposed development is located in close proximity to areas containing Dolomitic ground and, therefore, requires confirmation from a Geotechnical Study.
    - A comprehensive geotechnical study is completed before the detailed design stage of this development.
    - The guidelines described in **Section 14 – STORMWATER MANAGEMENT & GUIDELINES** should be incorporated into the detailed design of the development.

    - The policy described in **Section 15 – STORMWATER MANAGEMENT POLICY** be implemented.
- Impact Statement;
    - Concerning this report, associated assessment, and the findings made within, SKERP Consulting Engineers believes that the Watt & Witpoortjie Solar PV Facility and associated grid infrastructure will have a nominal impact on the existing stormwater catchments. The project is therefore deemed acceptable from a stormwater perspective, provided this report's recommendations and mitigation measures are implemented. Hence, Environmental Authorisation (EA) should be granted for the EIA application.
    - This document should also be read in conjunction with the EMPr. The developer, owner, and professional team shall adhere to the requirements and conditions set out in the EMPr.

REFERENCES

Climate Data for Cities Worldwide (Brakpan) - ***www.en.climate-data.org***

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South African National Roads Agency – *Drainage Manual 6th Edition (2013)*

Chapelle, Dr Kimberley – *Paleontology Specialist Study, Proposed Development of the Watt and Witpoortjie Solar PV Facility (September 2023)*

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APPENDIX A: SPECIALIST CURRICULUM VITAE