





POFADDER WIND FACILITY 1 (PTY) LTD

POFADDER WIND ENERGY FACILITY 1

Stormwater Management Plan

Issue Date: 27th July 2022
Revision No: 1
Project No: 16876
Document No: SW_P1

Date:	27 th July 2022	
Document Title:	Pofadder Wind Energy Facility 1 Stormwater Management Plan	
Revision Number:	1	
Author:	Merchandt Le Maitre (Pr. Tech Eng.)	
Signature:	 Pr. N°: 2018300094	Date: 27 th July 2022
Reviewed:	Richard Hirst (Pr Tech Eng.)	
Signature:	 Pr. N°: 2018300110	Date: 27 th July 2022
For:	POFADDER WIND FACILITY 1 (PTY) LTD	
<p>Confidentiality Statement</p> <p>© SiVEST SA (Pty) Ltd</p> <p>All rights reserved</p> <p><i>Copyright is vested in SiVEST SA (Pty) Ltd in terms of the Copyright Act (Act 98 of 1978). This report is strictly confidential and is to be used exclusively by the recipient.</i></p> <p><i>Under no circumstances should this report, or information contained therein be distributed, reprinted, reproduced or transmitted in any form or by any means, electronic or mechanical, without the written consent of SiVEST SA (Pty) Ltd.</i></p>		

EXECUTIVE SUMMARY

Objective

The Applicant, Pofadder Wind Facility 1 (PTY) LTD, proposes the construction of a wind energy facility (WEF), known as the Pofadder WEF 1 located on a site ±35 km south-east of Pofadder within the Kai !Garib Local Municipality and the Z F Mgcawu District Municipality in the Northern Cape Province. At this stage, the proposed Pofadder WEF 1 will comprise up to twenty-eight (28) wind turbines with a maximum total energy generation capacity of up to approximately 228 MW.

The main objective of the 'Stormwater Management Plan' is to determine the impact/s of the proposed development on the immediate and greater area concerning stormwater and to include these findings in the Environmental Impact Assessment (EIA) submission. The assessment will comprise a desktop assessment and include preliminary stormwater-related matters arising during the construction phase, through the Operation & Maintenance Phase, up to and including the decommissioning phase of the development.

The proposed Pofadder Wind Energy Facility 1 forms part of cluster development with two additional developments adjacent to this facility as separate EIA applications: - Pofadder Wind Energy Facility 2 and Pofadder Wind Energy Facility 3. Although this report only focuses on the Pofadder WEF 1, all three developments are considered for this study as they share common boundaries, drainage lines and catchments.

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 important.

The proposed development / infrastructure 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 during the construction phases 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 catchment.

Many mitigation measures are proposed to accommodate the development and reduce the impact on the surrounding area.

Recommendation

Concerning this report, the associated assessment and the findings made within, it is SiVEST's opinion that the Pofadder WEF 1 will have a nominal impact on the existing stormwater catchment. The project is therefore deemed acceptable from a stormwater perspective, provided the recommendations and mitigation measures in this report are implemented. Hence, Environmental Authorisation (EA) should be granted for the EIA application.

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

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 in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- 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 in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of Specialist:

Name of Company: SiVEST SA (PTY) Ltd

Date: 27th July 2022

POFADDER WIND FACILITY 1 (PTY) LTD

POFADDER WIND ENERGY FACILITY 1

STORMWATER MANAGEMENT PLAN

CONTENTS

1	INTRODUCTION.....	10
2	WIND ENERGY FACILITY COMPONENTS.....	10
	2.1 WEF Components.....	10
	2.2 Grid Connection Components.....	11
3	OBJECTIVE & SCOPE OF WORK.....	11
	3.1 Legal Requirement & Guidelines.....	12
4	SPECIALIST CREDENTIALS.....	12
5	ASSUMPTIONS AND LIMITATIONS.....	13
6	PROJECT DESCRIPTION.....	13
	6.1 Locality.....	13
7	GEOTECHNICAL STUDY.....	15
	7.1 Palaeontology Impact Assessment.....	15
8	CLIMATE.....	17
	8.1 Climate Classification.....	17
	8.2 Average Temperature.....	17
	8.3 Mean Annual Precipitation (MAP).....	18
	8.4 Humidity.....	19
	8.5 Design Rainfall.....	19
9	SURFACE HYDROLOGY.....	20
	9.1 Drainage of Catchment.....	20
	9.1.1 Primary Catchment.....	20
	9.1.2 Quaternary Catchment.....	21
10	STORMWATER MANAGEMENT.....	21

10.1	Impact of Development	21
10.2	The Purpose of Stormwater Management	22
10.3	Stormwater Management Policies & Design Guidelines	22
10.4	Stormwater Management Philosophy	22
10.5	Stormwater Management Drainage System	23
11	PRE-DEVELOPMENT RUN-OFF CHARACTERISTICS	23
11.1	Catchment Description	23
11.2	Site Topography	23
11.3	Site Vegetation	24
11.4	Geotechnical Conditions	25
11.5	Hardstand Areas.....	26
11.6	Run-Off Coefficient.....	26
12	POST-DEVELOPMENT RUN-OFF CHARACTERISTICS.....	28
12.1	Site Development Plan (SDP).....	28
12.2	Site Topography	28
12.3	Geotechnical Conditions	28
12.4	Developed Components.....	29
12.5	Run-Off Coefficient.....	29
13	SURFACE MODELLING	32
13.1	Modelling Selection	32
13.2	Surface Run-Off Modelling Results.....	32
14	STORMWATER MANAGEMENT & GUIDELINES	32
14.1	Buildings.....	33
14.2	Roof Drainage	33
14.3	Parking and Paved Areas.....	33
14.4	Roads	33
14.5	Subsurface Disposal of Stormwater	35
14.6	Channels	35
14.7	Energy Dissipation.....	36
14.8	Open Trenches.....	36
14.9	Stockpiles	36

14.10	Stormwater Pollution Control.....	36
15	STORMWATER MANAGEMENT POLICY	37
16	CONCLUSION & IMPACT STATEMENT.....	38
17	REFERENCES	38
	APPENDIX A: SPECIALIST CURRICULUM VITAE.....	39

LIST OF TABLES

Table 4.1	Specialist Credentials & Experience	12
Table 5.1	Technical Specification for Pofadder WEF 1	13
Table 7.1	Explanation of Figure 7:1 and Approximate Ages	16
Table 8.1	Pofadder WEF 1 Design Rainfall Data	20
Table 11.1	Pre-Development Run-Off Coefficient	26
Table 12.1	Post-Development Run-Off Coefficient.....	29
Table 13.1	Pre-Development Modelling Results.....	32
Table 13.3	Post-Development Modelling Results	32

LIST OF FIGURES

Figure 6:1	Pofadder WEF - Regional Context.....	14
Figure 6:2	Pofadder WEF - Site Locality	15
Figure 7:1	Geological Map of Proposed Development Pofadder WEF 1,2 & 3	16
Figure 8:1	Average Temperature – Pofadder, South Africa.....	18
Figure 8:2	Average Rainfall – Pofadder, South Africa	18
Figure 8:3	Average Rainfall Days – Pofadder, South Africa	19
Figure 8:4	Average Relative Humidity – Pofadder, South Africa	19
Figure 9:1	Department of Water and Sanitation (DWS) – Primary Catchments	21
Figure 11:1	Larger Drainage Lines (Blue) outside the development	24
Figure 11:2	Current Site Vegetation (2022 - High Rainfall).....	25
Figure 11:3	Typical Drainage Lines.....	25
Figure 11:4	Pofadder WEF 1 Development Area– Pre-Development Overland Flow	27
Figure 12:1	Pofadder WEF 1 SDP (Indicated in blue)	28
Figure 12:2	Pofadder WEF 1 – Post-Development Overland Flow.....	31
Figure 14:1	Typical Road Cross Section showing side drains	33
Figure 14:2	Typical Stormwater Mitre Drain / Channel	34
Figure 14:3	Typical Detail of a Cut-Off wall.....	34
Figure 14:4	Typical Low-Level Concrete structure.....	35

Figure 14:5 Typical Stormwater Headwall with Energy Dissipators..... 35
Figure 14:6 Typical Erosion Control 36

1 INTRODUCTION

SiVEST Civil Engineering Division has been appointed by the Pofadder Wind Facility 1 (Pty) Ltd. (hereafter referred to as "Pofadder 1" or "Pofadder WEF 1") to complete a Stormwater Management Plan (SWMP) for the proposed 228 MWac Pofadder Wind Energy Facility 1 and associated grid infrastructure (hereafter referred to as the "proposed facility / facilities"). The facility is situated ± 35 km south-east of Pofadder within the Kai !Garib Local Municipality and the Z F Mgcawu District Municipality in the Northern Cape Province.

The proposed facility and associated grid infrastructure between Springbok and Upington will not be located within a Renewable Energy Development Zone (REDZ).

The proposed Pofadder Wind Energy Facility 1 forms part of cluster development with two additional developments adjacent to this facility as separate EIA applications: - Pofadder Wind Energy Facility 2 and Pofadder Wind Energy Facility 3. Although this report only focuses on the Pofadder WEF 1, all three developments are considered for this study as they share common boundaries, drainage lines and catchments.

2 WIND ENERGY FACILITY COMPONENTS

The WEF will consist of the following:

2.1 WEF Components

At this stage, the proposed Pofadder 1 WEF will comprise up to twenty-eight (28) wind turbines with a maximum total energy generation capacity of up to approximately 224 MW. In summary, the proposed Pofadder WEF 1 development will include the following components:

- Up to 28 wind turbines, each with a maximum of 8 MW output per turbine, with a maximum total export capacity of ± 224 MW. This number, size and output of turbines will be subject to allowable limits in terms of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP).
- Each wind turbine will have a maximum hub height and a rotor diameter of up to approximately 200 m;
- Concrete turbine foundations and turbine hardstands;
- Each turbine will have a circular foundation with a diameter of up to 32 m. The turbine foundation will be placed alongside the 45 m wide hardstand, resulting in an area of about 45 m x 32 m that will be permanently disturbed for the foundation. The combined permanent footprint for the turbines will be approximately 4.4 ha.
- Each turbine will have a crane hardstand of approximately 70 m x 45 m. The permanent footprint for turbine crane hardstands will be ± 9 ha.
- Each turbine will have a blade hardstand of approximately 80 m x 45 m (3 600 m²). The combined permanent footprint for blade hardstands will be ± 10 ha.
- One (1) new 33/132 kV on-site substation occupies an area of approximately 1.6 ha.
- The wind turbines will be connected to the proposed on-site substation via medium voltage (33 kV) underground cables, mainly running alongside the access roads. Where burying of cables is not possible due to technical, geological, environmental or topographical constraints, cables will be overhead via 33 kV monopoles.
- The main access road will be between 8 – 12 m wide (to allow vehicles to pass).

- Internal roads with a width of 6 – 8 m will provide access to each wind turbine. Existing farm roads will be upgraded and used wherever possible, although new site roads will be constructed where necessary.
- A 12 m wide corridor may be temporarily impacted during construction and rehabilitated to a 6 m wide corridor after construction. The internal gravel roads will have a 6 – 8 m wide surface and a 12m wide road clearance during construction. Additional space might be required for cut and fill, side drains and other stormwater control measures, turning areas and vertical and horizontal turning radii to ensure the safe delivery of the turbine components.
- Pofadder WEF 1 will have a total road network of approximately 48 km.
- One (1) construction laydown / staging area of up to approximately 7 ha (to be rehabilitated following construction). It should be noted that no on-site labour camps will be required to house workers overnight as all workers will be accommodated in the nearby towns and transported daily to the site (by bus);
- The gatehouse and security house will occupy an area of up to 0.5 ha.
- Battery Energy Storage System (BESS) of approximately 3.6 ha.
- One (1) permanent Operation and Maintenance (O&M) building (including offices, warehouses, workshops, canteen, visitors centre and staff lockers) occupying an area of up to 1 ha;
- The temporary establishment of a site camp and concrete batching plant occupying an area of up to 1.6 ha.
- Galvanised palisade fencing to be used at the substations with the maximum height of the fencing to be up to 3.5 m.
- Water will be sourced from either the Local Municipality, supplied from a private contractor and trucked in, from existing boreholes within the application site or from a new borehole if none of these options are available.

2.2 Grid Connection Components

In order to evacuate the energy generated by the WEF's to supplement the national grid, Pofadder Grid (Pty) Ltd is proposing two grid connection alternatives which will be assessed in a separate Integrated Grid Basic Assessment Reports (BAR).

3 OBJECTIVE & 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 consist of the following:

- a) A site investigation (Completed on 15th July 2022).
- 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 Requirement & 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

Merchandts Le Maitre from SiVEST Consulting Engineers compiled this Stormwater Management Plan. He has a B Tech (Baccalaureus Technologiae) in Civil Engineering with over 17 years of experience, with 12 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 / layout designs and glint & glare assessments. A full Curriculum Vitae is included in 'Appendix A.

Table 4.1 Specialist Credentials & Experience

Company	SiVEST (Pty) Ltd
Contact Details	merchandtm@sivest.co.za
Qualifications	B Tech (Baccalaureus Technologiae) in Civil Engineering
Professional Registrations & Memberships	<ul style="list-style-type: none"> • Pr. Tech Eng – Engineering Council of South Africa • MSAICE – Member of South African Institute of Civil Engineers • SAWEA – South African Wind Energy Association
Expertise to carry out the Stormwater Management Plan	<ul style="list-style-type: none"> • Dyansons Klip 5 • De Aar Solar • Droogfontein Solar • Mierdam Solar • Prieska PV • Hoekplaas PV • Noupoort WEF • Copperton PV • Klipgats PV • Euphorbia PV • Verbena PV • Hillardia PV

5 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are to be noted:

- The analysis is based on the information provided at the time by Pofadder Wind Facility 1 and its representatives.
- Digital Terrain Model: 25m DEM from NGI (2014) & 2m DEM from GeoSmart (2016:2919BA, 2919BB, 2919BC & 2919BD)
- Technical Specifications for the facility are:

Table 5.1 Technical Specification for Pofadder WEF 1

Technical Component	Dimensions
Number of Turbines	Maximum of 28
Capacity	≤ 228 MWac
Hub Height	≤ 200 m
Rotor Diameter	≤ 200 m
Construction Period (assumed)	± 24 months (TBC)
Expected Lifespan	20 - 25 years (TBC)
Road Width	Up to 8 m
Length of Internal Roads	±48 km

- 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 construction time.

6 PROJECT DESCRIPTION

6.1 Locality

Pofadder WEF 1 and associated infrastructure is located ±35 km south-east of Pofadder in the Northern Cape Province. The facility is ±22 km from Road R358 regional road (MR0736) and 29 km from Road DR2986 to the N14 Freeway between Springbok and Upington in the Kai !Garib Local Municipality and the Z F Mgcawu District Municipality as indicated in **Figure 6:1**.

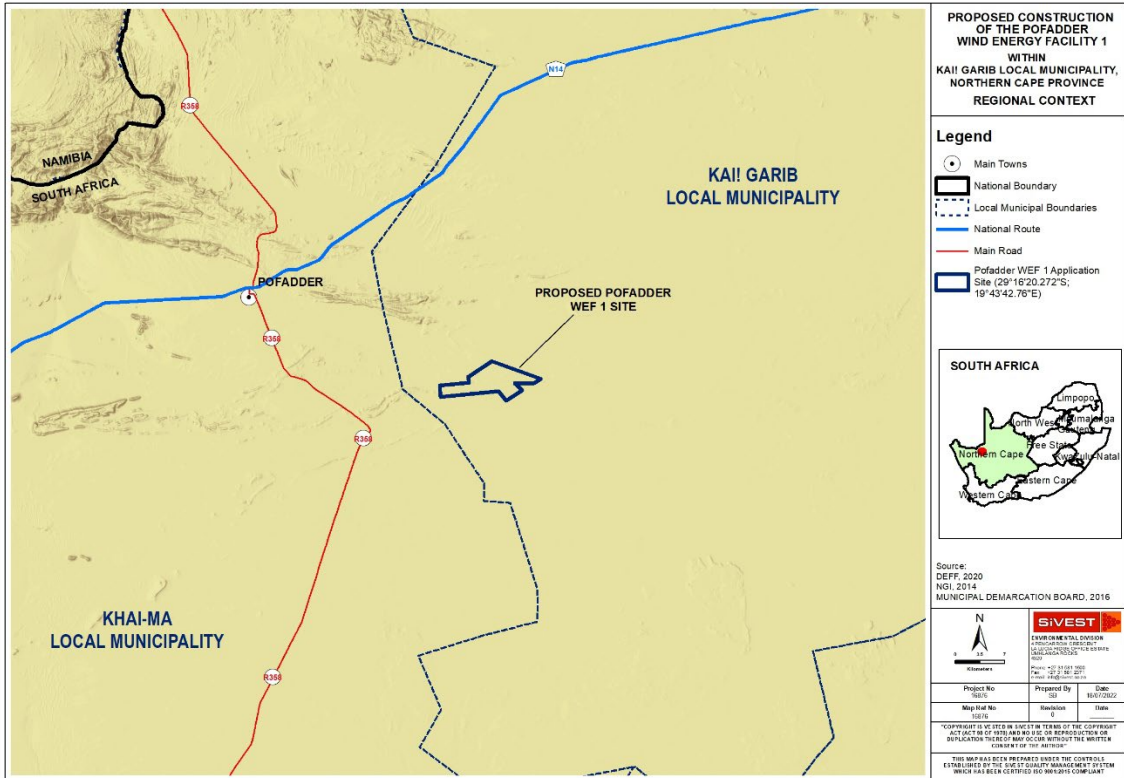


Figure 6:1 Pofadder WEF - Regional Context

The WEF will be located on the following properties (Refer to **Figure 6:2**):

- Remaining Extent of the Farm Ganna-Poort No. 202
- Remaining Extent of the Farm Lovedale No. 201
- Portion 3 of the Farm Sand-Gat No. 150

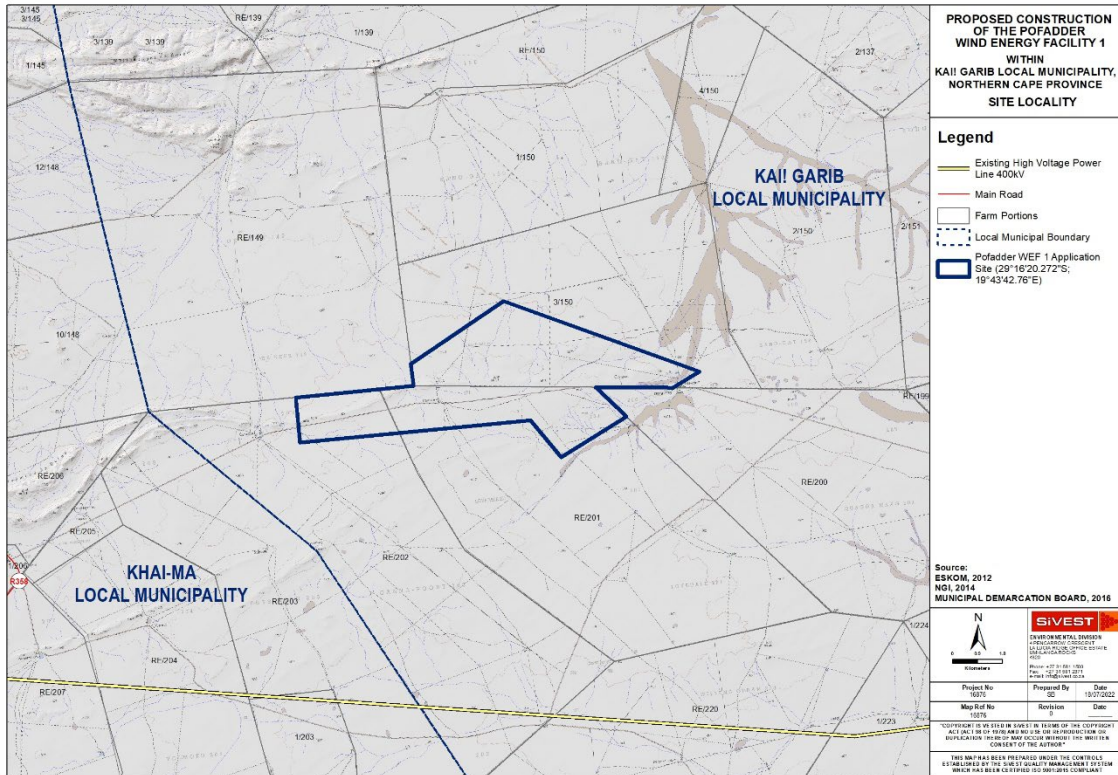


Figure 6:2 Pofadder WEF - Site Locality

7 GEOTECHNICAL STUDY

7.1 Palaeontology Impact Assessment

A comprehensive Palaeontology Impact Assessment¹ for the proposed development was completed in February 2022 by Prof. Marion Bamford on the proposed sites indicated in **Section 6**.

A summary extract from the Palaeontological Impact Assessment confirms the site comprises the following geological context. Refer to **Figure 7:1** and **Table 7:1**:

¹ Bramford, Prof M (2022). Paleontology. Pofadder WEFs 1,2,3. Pofadder Wind Facility 1 (Pty) Ltd

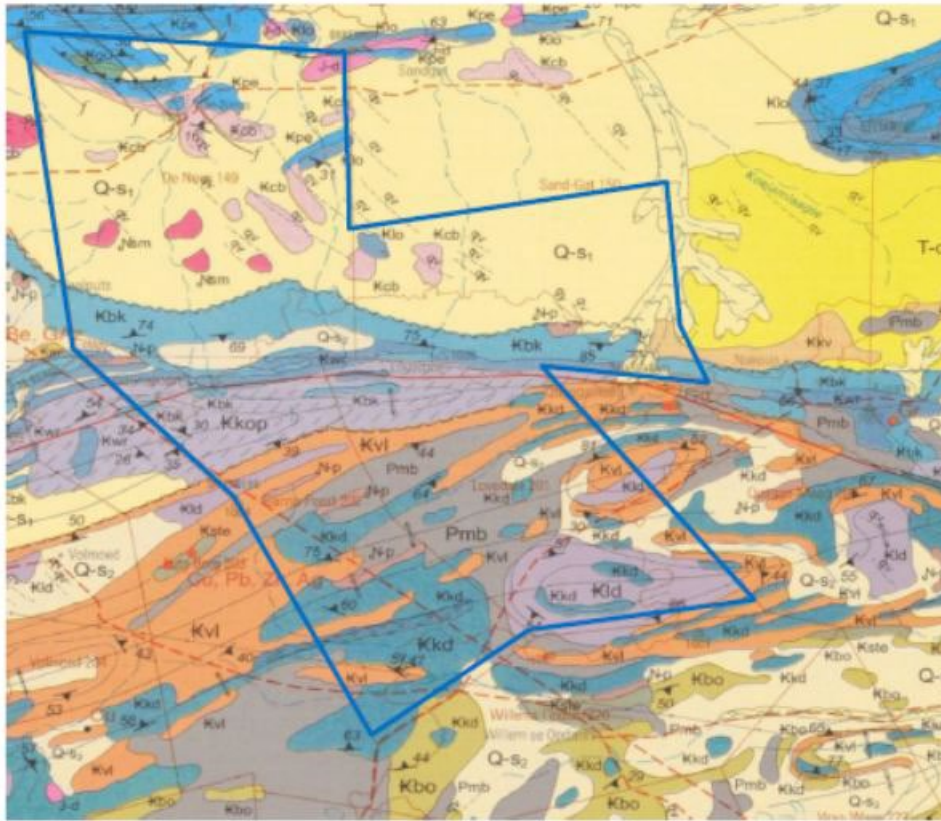


Figure 7:1 Geological Map of Proposed Development Pofadder WEF 1, 2 & 3

Abbreviations of the rock types are explained in **Table 7:1** below:

Table 7.1 Explanation of **Figure 7:1** and Approximate Ages

Symbol	Group / Formation	Lithology	Approximate Age
Qs-1	Quaternary Sands	Re windblown sands & Dunes	Quaternary, ca 2.5 Ma to present
Qs-2	Quaternary Sands	Sand, Scree, Rubble, Sandy Soil	
T-c	Tertiary Calcrete	Calcrete	Tertiary, ca 65 Ma to 2.5 Ma
Jd	Jurassic Dyke	Dolerite	Ca 183 Ma
Pmb	Mbizane Formation Dwyka Group Karoo Supergroup	Diamictite, Tillites, Subordinate Sandstone and Mudstone	Late Carboniferous to Early Permian. Ca 300 – 290 Ma
Kbk	Brulkolk Formation Bushmanland Group Namaqua – Natal Suite	Gneiss	>1200 Ma
Kvl	Voelmoed Formation Kamiesberg Group	Quartzite, Schist, Ironstone	Ca 1600 Ma

Symbol	Group / Formation	Lithology	Approximate Age
	Namaqua – Natal Suite		
Kkd	Kraandraai Formation Kamiesberg Group Namaqua – Natal Suite	Gniess	Ca 1600 Ma
Kld	Lekkerdrink Formation Gladkop Group Namaqua – Natal Suite	Gniess	2050-1700 Ma
Kkp	Koeipoort Formation Gladkop Metamorphic Suite Namaqua – Natal Suite	Gniess	2050-1700 Ma

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

- *Tertiary calcretes, quaternary sands (red & grey) and alluvium covering the site*
- *The metamorphic rock of the Namaqua – Natal belts underlies the Karoo sediments.*

Material excavation (soils and sand) is expected to be soft in the upper layers of alluvium / sand with *intermediate to hard* excavation techniques below in the metamorphic rock.

We recommend that a comprehensive Geotechnical Report be carried out to form part of the detailed design stage and refinement of the SWMP.

8 CLIMATE

8.1 Climate Classification²

Pofadder WEF 1 and associated infrastructure is located ±35 km south-east of Pofadder in the Northern Cape Province. Referring to the Klöppen-Geiger climate classification system, the Northern Cape Province has a variety of climates and is predominantly dominated by hot desert climates (type 'BWh') and cold semi-arid climates (type 'BSk'). The Pofadder area is classified as a hot desert climate (type 'BWh').

8.2 Average Temperature³

The Average Maximum temperatures range between 18.3° and 34.3°C. January is the year's warmest month, with an average high temperature of 34.3°C. July is the coldest month of the year with an average low temperature of 7.4°C. Refer to **Figure 8:1** below.

² en-climate-data

³ Weather Atlas

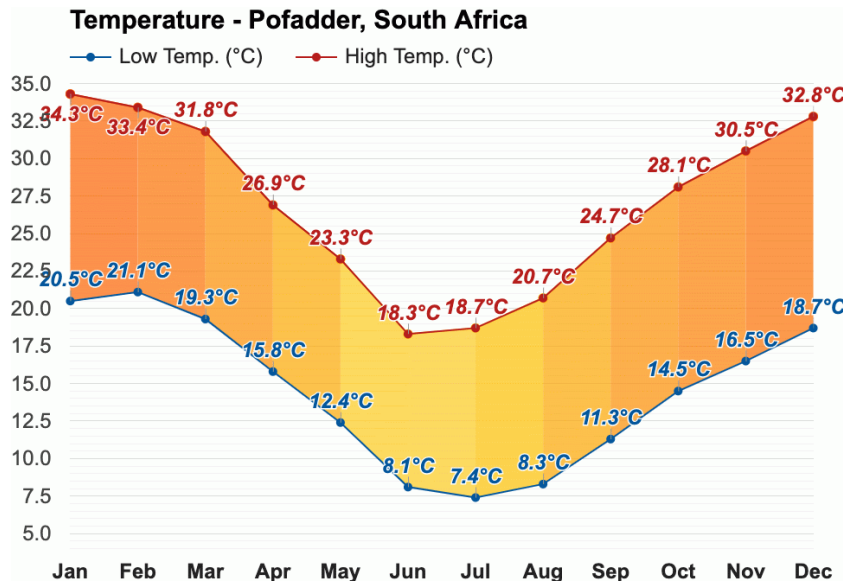


Figure 8:1 Average Temperature – Pofadder, South Africa

8.3 Mean Annual Precipitation (MAP)⁴

As mentioned in **Section 8.1** above, the Pofadder region is a hot desert climate with an annual average rainfall of ±45 mm, mainly between December and April. February is, on average, the wettest month of the year, with ±12 mm accumulated for the month. The driest months with the least amount of rainfall of ±1mm accumulated for the month is the month of July, August and September. Refer to **Figure 8:2** below.

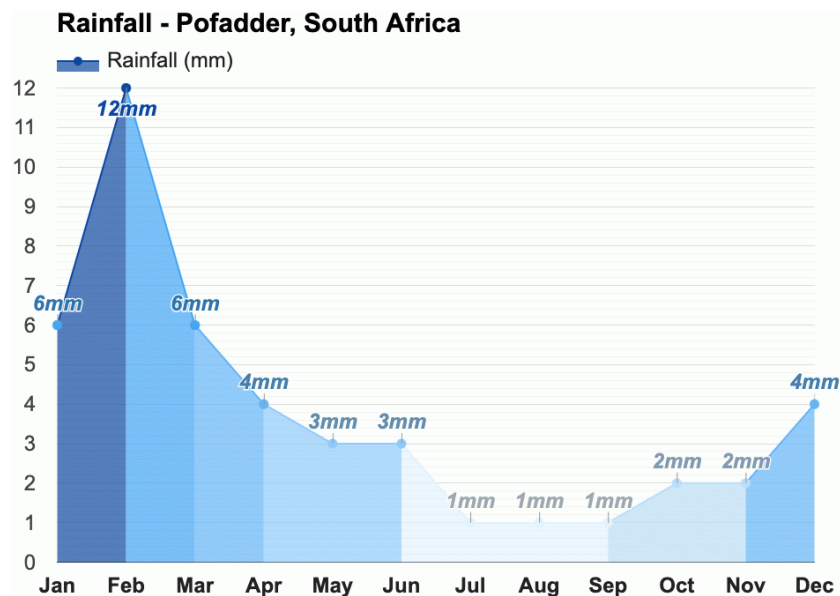


Figure 8:2 Average Rainfall – Pofadder, South Africa

The average rainfall days per annum is ±29 days, with February having the highest number of rainfall days (5.1 days). The month with the least rainfall days is November (0.8 days). Refer to **Figure 8.3** below.

⁴ Weather Atlas

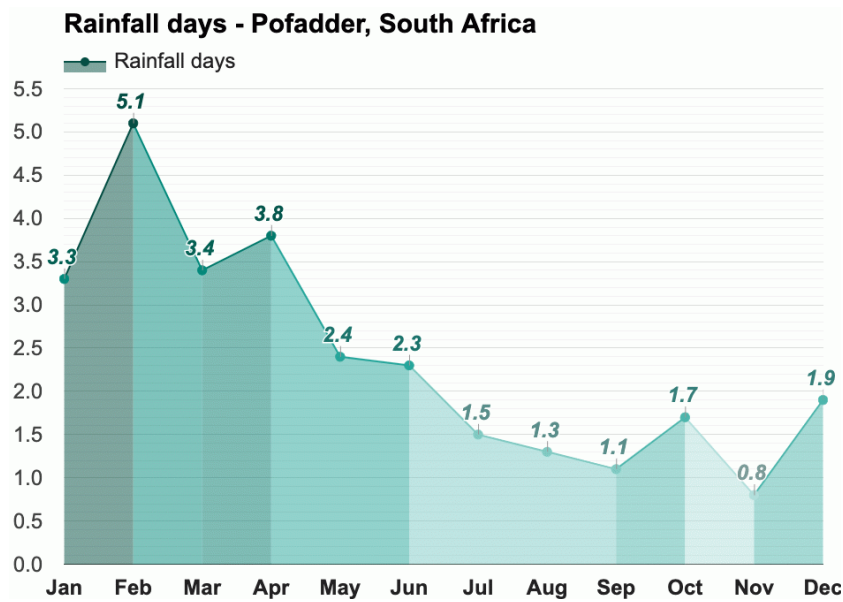


Figure 8:3 Average Rainfall Days – Pofadder, South Africa

8.4 Humidity⁵

The region's relative humidity ranges from a maximum of 46% in June to a minimum of 25% in November.

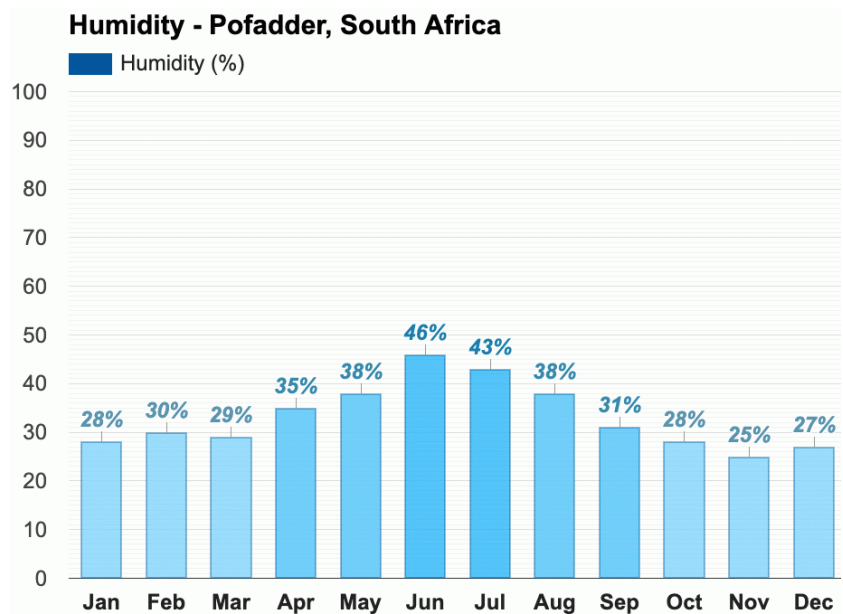


Figure 8:4 Average Relative Humidity – Pofadder, South Africa

8.5 Design Rainfall

Design Rainfall Estimation⁶ software was used to obtain the rainfall data (tabulated below in **Table 8:1**) required for the run-off calculations.

⁵ Weather Atlas

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

Table 8.1 Pofadder WEF 1 Design Rainfall Data

Return Period		2yr	5yr	10yr	20yr	50yr	100yr	200yr
Duration		Rainfall Depth (mm)						
5	min	5.80	9.20	11.60	14.10	17.80	20.70	24.00
10	min	8.60	13.50	17.10	20.90	26.20	30.60	35.30
15	min	10.80	16.90	21.50	26.20	32.90	38.40	44.30
30	min	13.20	20.70	26.20	32.00	40.20	46.90	54.10
45	min	14.80	23.30	29.50	35.90	45.10	52.70	60.90
60	min	16.10	25.30	32.00	39.10	49.00	57.30	66.10
90	min	18.10	28.40	36.00	43.90	55.10	64.40	74.30
120	min	19.70	30.90	39.10	47.70	59.90	70.00	80.80
240	min	22.40	35.10	44.50	54.30	68.20	79.60	91.90
360	min	24.10	37.90	48.00	58.50	73.50	85.80	99.10
480	min	25.50	40.00	50.60	61.80	77.50	90.60	104.60
600	min	26.60	41.70	52.80	64.40	80.80	94.40	109.00
720	min	27.50	43.10	54.60	66.60	83.60	97.70	112.80
960	min	29.00	45.50	57.60	70.30	88.20	103.00	119.00
1200	min	30.20	47.40	60.00	73.20	92.00	107.40	124.00
1440	min	31.30	49.00	62.10	75.80	95.20	111.10	128.30
1	day	25.70	40.30	51.10	62.30	78.20	91.40	105.50
2	days	30.00	47.10	59.70	72.80	91.40	106.80	123.30
3	days	32.90	51.60	65.40	79.80	100.20	117.00	135.10
4	days	34.30	53.80	68.10	83.10	104.40	121.00	140.80
5	days	35.40	55.60	70.40	85.90	107.80	125.90	145.40
6	days	36.40	57.10	72.20	88.10	110.70	129.30	149.20
7	days	37.20	58.30	73.90	90.10	113.20	132.20	152.60

9 SURFACE HYDROLOGY

9.1 Drainage of Catchment

9.1.1 Primary Catchment

The site falls within the 'Orange River' drainage catchment (Primary Catchment 'D'), covering an area of $\pm 973\,000\text{ km}^2$ (including the Vaal River catchment). To the north, the Orange River catchment extends into Namibia, to the east, the Drakensburg mountains, to the south, the Western Cape and Eastern Cape provincial boundaries to the south, ultimately flowing westwards between South Africa and Namibia towards the Atlantic Ocean, shown in **Figure 9.1** below.

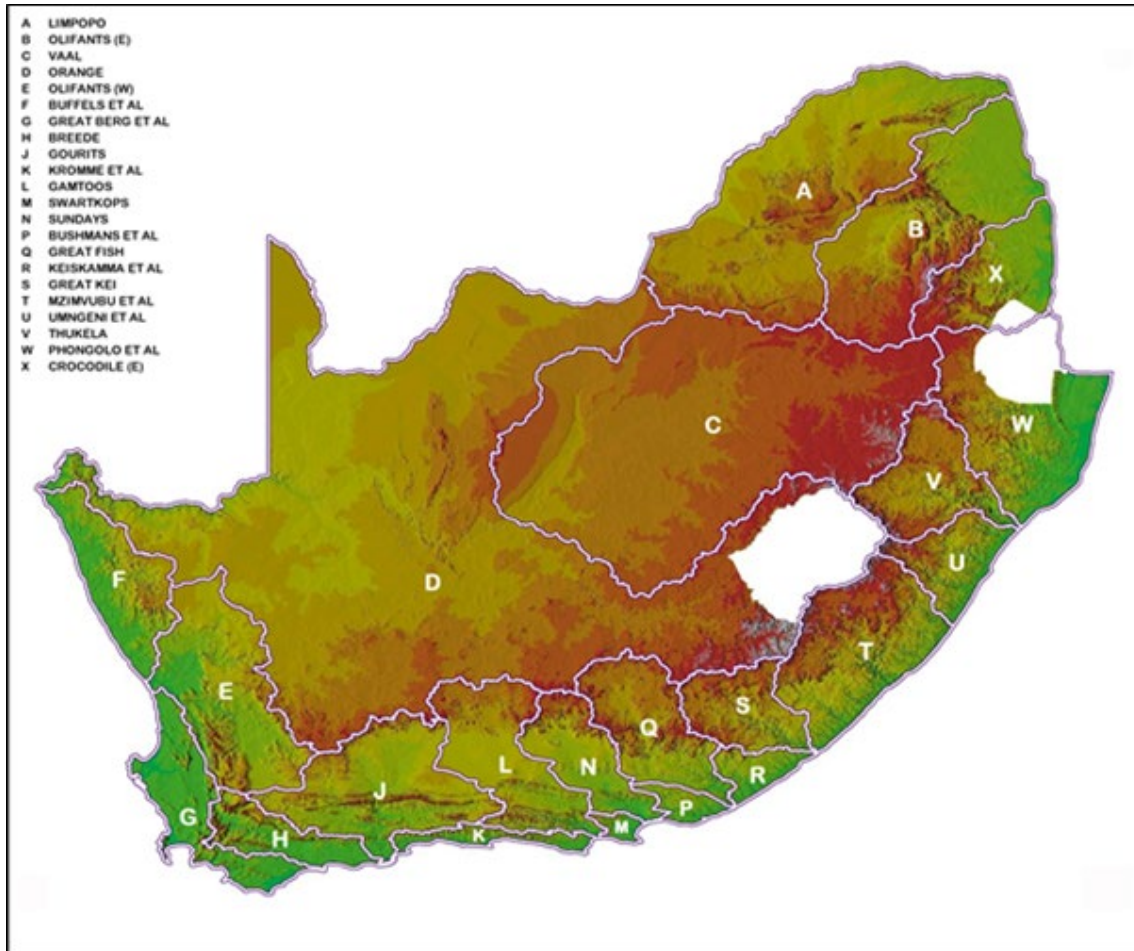


Figure 9:1 Department of Water and Sanitation (DWS) – Primary Catchments

9.1.2 Quaternary Catchment

The proposed facility is located in Quaternary Catchment D81F, D81G and D53G. Catchment D81F and D81G form part of the upper reaches of the Kaboep Rivier, and catchment D53G forms part of the upper reaches of the Sout River, that then ultimately flows into the lower reaches of the Orange River.

10 STORMWATER MANAGEMENT

10.1 Impact of Development⁷

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

As a result of the proposed development, stormwater management is key to reducing the negative impacts and keeping the receiving environment in its natural state. The management is achieved with

⁷ Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology

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 Management⁸

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 the stormwater allows the public to protect their health, welfare, and safety. It also provides for the protection of 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.
- 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 focus more on the detrimental effect to 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 Kai !Garib Local Municipality and the Z F Mgcawu District Municipality, and, to our knowledge, specific policies, design guidelines, and standards are not available. Therefore, we recommend that the stormwater drainage system refers to the "Red Book⁹" and the "Drainage Manual¹⁰".

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 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 in keeping 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

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

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*

- 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 seen as dual systems incorporating minor and major storm return periods.

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

The major stormwater drainage system caters for severe, infrequent storm events supported by the minor drainage system. Storms of a major nature include less frequent return periods such as 20 years and more.

11 PRE-DEVELOPMENT RUN-OFF CHARACTERISTICS

11.1 Catchment Description

The development falls within eight (8) minor catchment areas, forming part of the three (3) quaternary catchments mentioned in **Section 9**. The development's catchment areas vary in size ranging from 6.1 km² to 241 km² and flat (<1%). The development catchment shows no evidence of clearly defined watercourses with overland sheet flow occurring in multiple directions through the respective catchments.

The development is located in a rural area of the Northern Cape Province where sheep farming predominantly occurs. Referring to the SANBI Vegetation Map (2012), the vegetation in the area is described as 'Bushmanland Arid Grassland'.

The proposed WEF development is located away from any streams, rivers or floodplains and, therefore, will not be impacted by a flood line.

11.2 Site Topography

Extensive, irregular plains cover the area on a slightly sloping plateau. All three developments combined have a natural ridge line to the north, dividing the development into two catchments, one flowing north and the other south-east. The drainage lines to both catchments ultimately join up again in the Orange River. As mentioned above, no defined drainage lines run through the proposed developments; however, more prominent drainage lines, namely the Kaboep Rivier, Noursrivier, Brabeesrivier and Hartbeesrivier are located within the Quaternary catchments outside the proposed developable area. (Refer to **Figure 11:1** below).

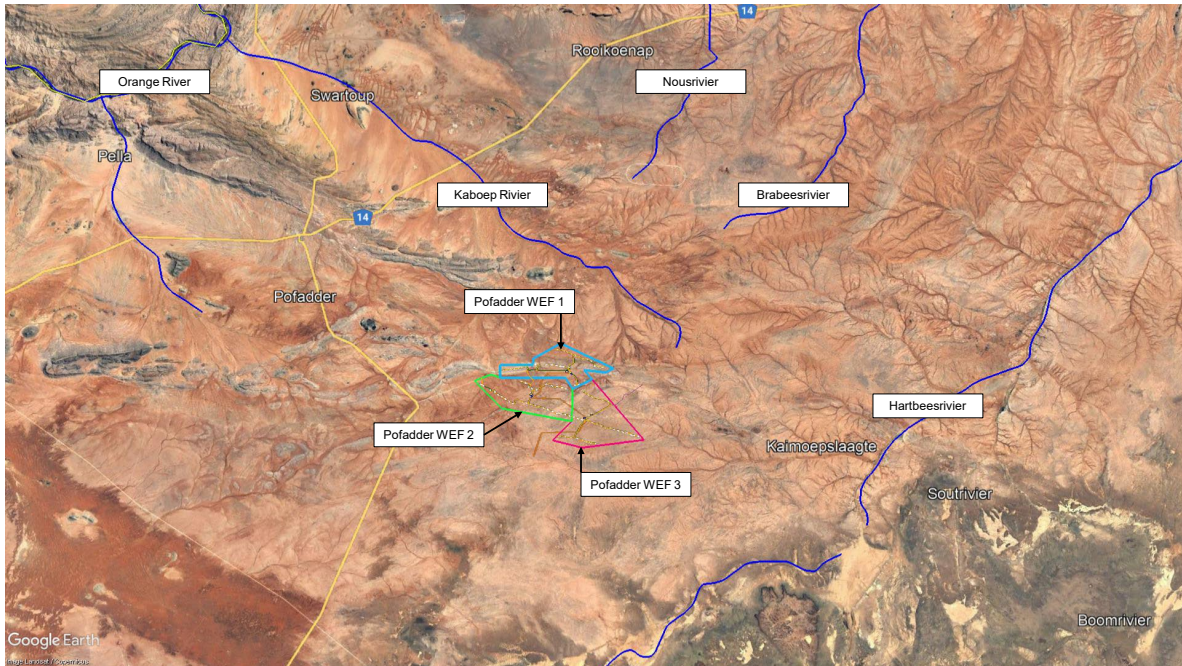


Figure 11:1 Larger Drainage Lines (Blue) outside the development

Please note that detailed contour data was not available for the broader study area. Therefore, the National Geo-Spatial Information (NGI) 's 25 m DEM was sourced to provide terrain data for this area.

Contours were generated from the Digital Elevation Model (DEM) at 2.5 m intervals using ESRI's 3D Analyst Extension for ArcGIS. Therefore, we recommend that an updated and detailed SWMP be completed once a more accurate Digital Terrain Model (DTM) of the site is available

From **Figure 11:2** and **Figure 11:3** 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 this area is made up of sparsely vegetated plains, dominated by white grasses giving the vegetation a semidesert 'steppe' character. In years of abundant rainfall, more vegetation and longer grass can be expected.



Figure 11:2 Current Site Vegetation (2022 - High Rainfall)



Figure 11:3 Typical Drainage Lines

Figure 11:2 and **Figure 11:3** indicates the typical ground cover on the site, with the following percentage splits applicable: -

- Thick Bush & Plantations – 0%
- Light Bush & Farmlands – 0%
- Grasslands – 50%
- No Vegetation – 50%

11.4 Geotechnical Conditions

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

- Very Permeable – 20%
- Permeable – 70%
- 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

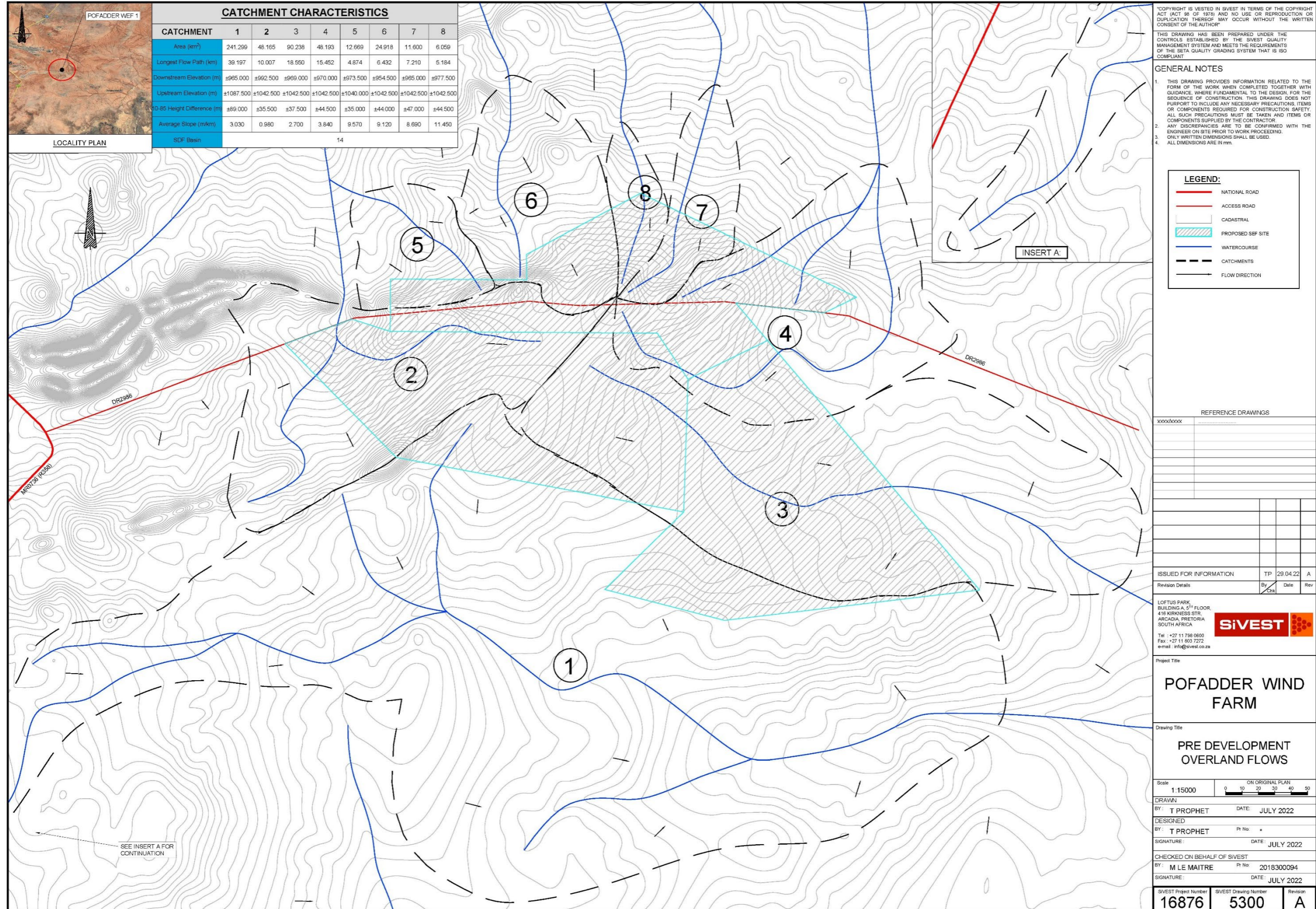
Surface Slope - Wetlands & Pans	0,03	95,0%	0,029
Surface Slope - Flat Areas (3-10%)	0,08	5,0%	0,004
Surface Slope - Hilly Areas (10-30%)	0,16	0,0%	0,000
Surface Slope - Steep Areas (>30%)	0,26	0,0%	0,000
Soil - Very Permeable	0,04	20,0%	0,008
Soil - Permeable	0,08	70,0%	0,056
Soil - Semi-Permeable	0,16	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 / Farmlands	0,11	0,0%	0,000
Vegetation - Grasslands	0,21	50,0%	0,105
Vegetation - No Vegetation	0,28	50,0%	0,140
			0,358

Based on the preceding table, we calculated a **PRE-DEVELOPMENT Run-Off Coefficient** of **0.358**.

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 11:4 Pofadder WEF 1 Development Area– Pre-Development Overland Flow



12 POST-DEVELOPMENT RUN-OFF CHARACTERISTICS

12.1 Site Development Plan (SDP)

Concerning the SDP, the proposed Pofadder WEF 1 layout will consist of a series of 28 turbines along with an access road, internal roads, substation, battery energy storage system (BESS), turbine laydown areas, auxiliary buildings, and external access roads etc. The total development area will cover a combined area of ±13 500 ha. In contrast, Pofadder WEF 1 will only cover ±3 600 ha, Pofadder WEF 2 ±4 800 ha and Pofadder WEF 3 ±5 100 ha.

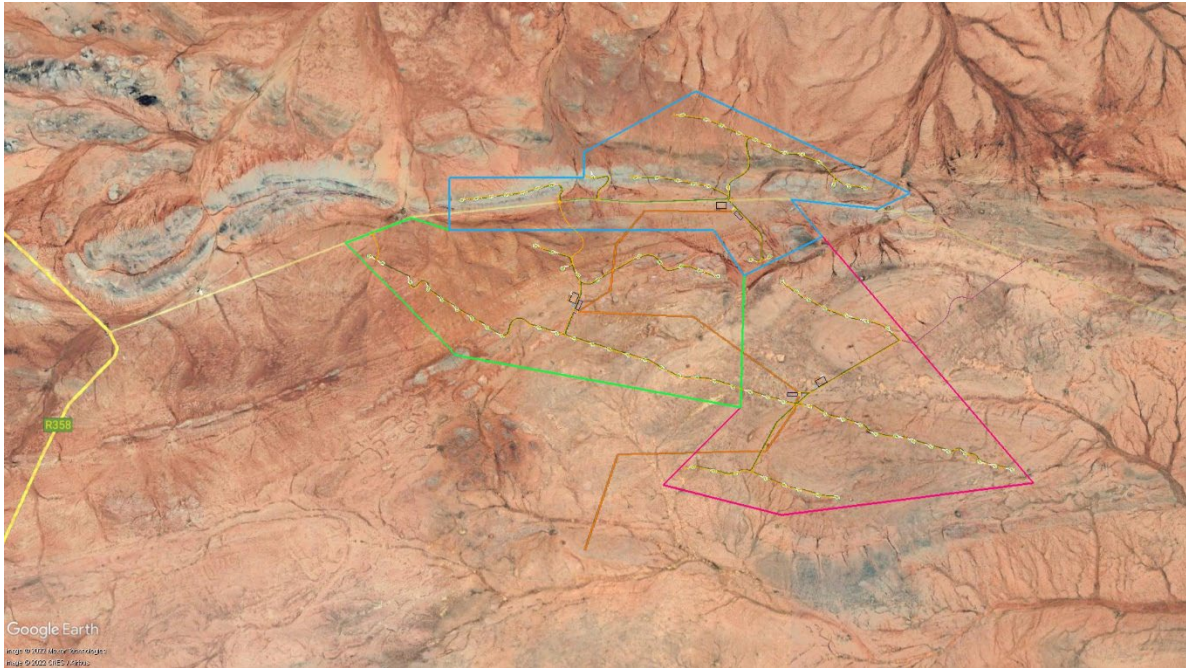


Figure 12:1 Pofadder WEF 1 SDP (Indicated in blue)

12.2 Site Topography

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

The following percentage splits are applicable: -

- Flatter Areas (0% to 3% slope) – 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 there would be little or no effect from the facility on the existing ground conditions.

The following percentages will be used: -

- Very Permeable – 20%
- Permeable – 70%

- 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 WTG's. 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 has therefore been assumed.

- Gravel Roads & Platforms – 94%
- WEF Facility – 6%
- Grasslands – 0%
- No Vegetation – 0%

12.5 Run-Off Coefficient

Based on *Table 3C.1* of the *Drainage Manual – 6th Edition*¹², the following run-off coefficients percentages have been assigned for this calculation: -

Table 12.1 Post-Development Run-Off Coefficient

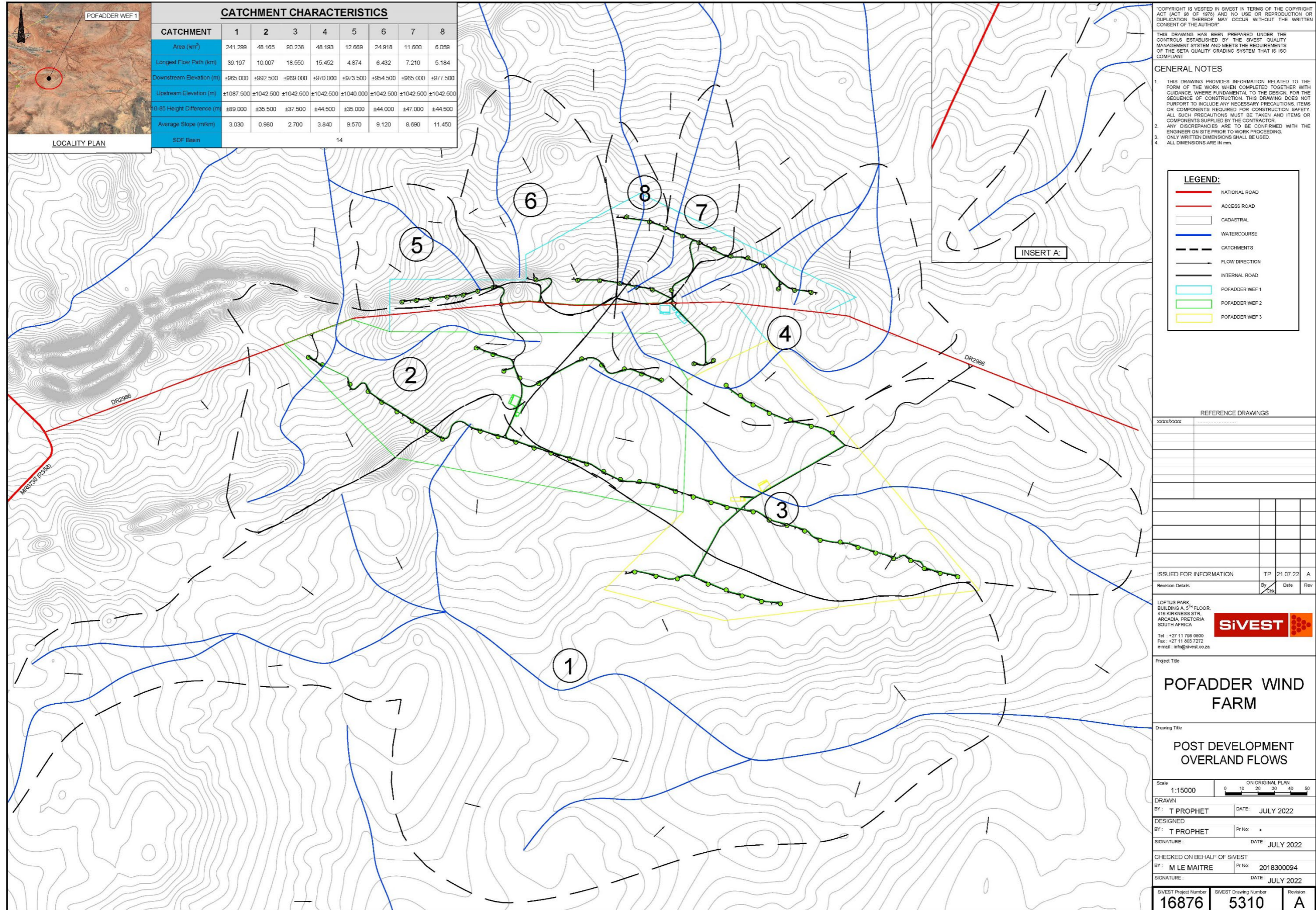
UN-DEVELOPED COMPONENT: Run-off Percentages			
Surface Slope - Wetlands & Pans	0,03	95,0%	0,029
Surface Slope - Flat Areas (3-10%)	0,08	5,0%	0,004
Surface Slope - Hilly Areas (10-30%)	0,16	0,0%	0,000
Surface Slope - Steep Areas (>30%)	0,26	0,0%	0,000
<hr/>			
Soil - Very Permeable	0,04	20,0%	0,008
Soil - Permeable	0,08	70,0%	0,056
Soil - Semi-Permeable	0,16	10,0%	0,016
Soil - Impermeable	0,26	0,0%	0,000
<hr/>			
Vegetation - Thick Bush / Plantations	0,04	0,0%	0,000
Vegetation - Light Bush / Farmlands	0,11	0,0%	0,000
Vegetation - Grasslands	0,21	50,0%	0,105
Vegetation - No Vegetation	0,28	50,0%	0,140
			0,358
DEVELOPED COMPONENT: Run-off Percentages			
Surface Slope - Wetlands & Pans	0,03	100,0%	0,030
Surface Slope - Flat Areas (3-10%)	0,08	0,0%	0,000
Surface Slope - Hilly Areas (10-30%)	0,16	0,0%	0,000
Surface Slope - Steep Areas (>30%)	0,26	0,0%	0,000
<hr/>			
Soil - Very Permeable	0,04	20,0%	0,008
Soil - Permeable	0,08	70,0%	0,056
Soil - Semi-Permeable	0,16	10,0%	0,016
Soil - Impermeable	0,26	0,0%	0,000

¹² *Drainage Manual 6th Edition, Published by The South African National Roads Agency SOC Ltd, 2013*

Gravel Roads & Platforms	0,50	94,0%	0,470
WEF Facilities	1,00	6,0%	0,060
Vegetation - Grasslands	0,21	0,0%	0,000
Vegetation - No Vegetation	0,28	0,0%	0,000
			0,640
RUN-OFF COEFFICIENT: Without DOLOMITE			
Percentage UN-DEVELOPED		99,0%	0,354
Percentage DEVELOPED		1,0%	0,006
TOTAL Run-Off coefficient			0,360

Based on the preceding table, we calculated a factored **POST-DEVELOPMENT Run-Off Coefficient** of **0.360**.

Figure 12:2 Pofadder WEF 1 – Post-Development Overland Flow



13 SURFACE MODELLING

13.1 Modelling Selection

EMPIRICAL and STATISTICAL METHODS were not considered for this project as insufficient hydrological records and observed points were available for the area. Therefore, a deterministic method has thus been selected to determine the 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 eight (8) minor catchments. **Section 13.2** below modelled the surface run-off for each catchment for Pre and Post-Development conditions.

13.2 Surface Run-Off Modelling Results

Table 13.1 Pre-Development Modelling Results

Return Period	Catchment No.							
	1	2	3	4	5	6	7	8
1 : 2 year	17,06	12,05	10,54	7,98	5,05	7,27	3,33	2,06
1 : 5 year	85,02	49,09	49,91	35,89	18,26	28,51	13,26	7,93
1 : 10 year	111,22	64,21	65,28	46,94	23,88	37,29	17,35	10,38
1 : 25 year	145,84	84,21	85,61	61,56	31,32	48,90	22,75	13,61
1 : 50 year	172,03	99,33	100,98	72,61	36,94	57,68	26,83	16,05
1 : 100 year	207,69	114,45	119,79	84,81	42,56	66,47	30,92	18,49

Table 13.2 Post-Development Modelling Results

Return Period	Catchment No.							
	1	2	3	4	5	6	7	8
1 : 2 year	17,06	12,05	10,54	7,98	5,05	7,27	3,33	2,06
1 : 5 year	85,02	49,09	49,91	35,89	18,26	28,51	13,30	7,95
1 : 10 year	111,22	64,21	65,28	46,94	23,88	37,29	17,39	10,40
1 : 25 year	145,84	84,21	85,61	61,56	31,32	48,90	22,81	13,64
1 : 50 year	172,03	99,33	100,98	72,61	36,94	57,68	26,91	16,09
1 : 100 year	207,69	114,45	119,79	84,81	42,56	66,47	31,00	18,54

The results above indicate that the proposed development will have little to no effect between 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.

14 STORMWATER MANAGEMENT & GUIDELINES

The buildings / structures within the development will require the control of stormwater run-off as per the stormwater management philosophy and policies of the local authority / municipality. The following guidelines are intended to assist in the design of the major and minor stormwater infrastructure and to

ensure 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 on the installation of the infrastructure. The onus is on the owner / developer to maintain the state of 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 in addition to 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 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-.

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. Regular side drains discharge points along roads for overland flow to continue as sheet flow towards drainage lines per pre-development conditions (Refer **Figure 6.1**). Where flow concentration is unavoidable, measures to incorporate the road into the major stormwater system should be taken, providing appropriately designed attenuation storage facilities at suitable points.

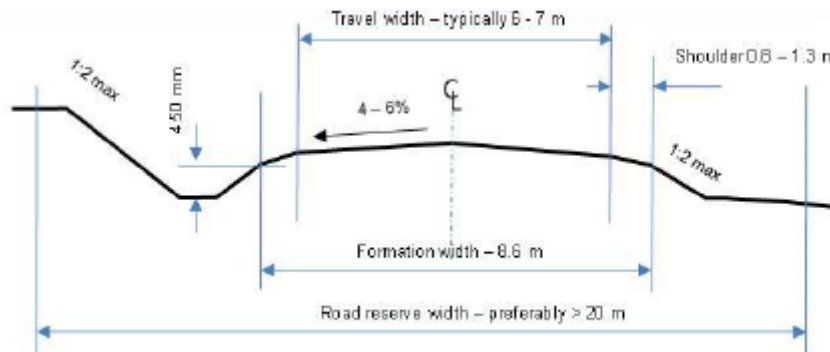


Figure 14:1 Typical Road Cross Section showing side drains

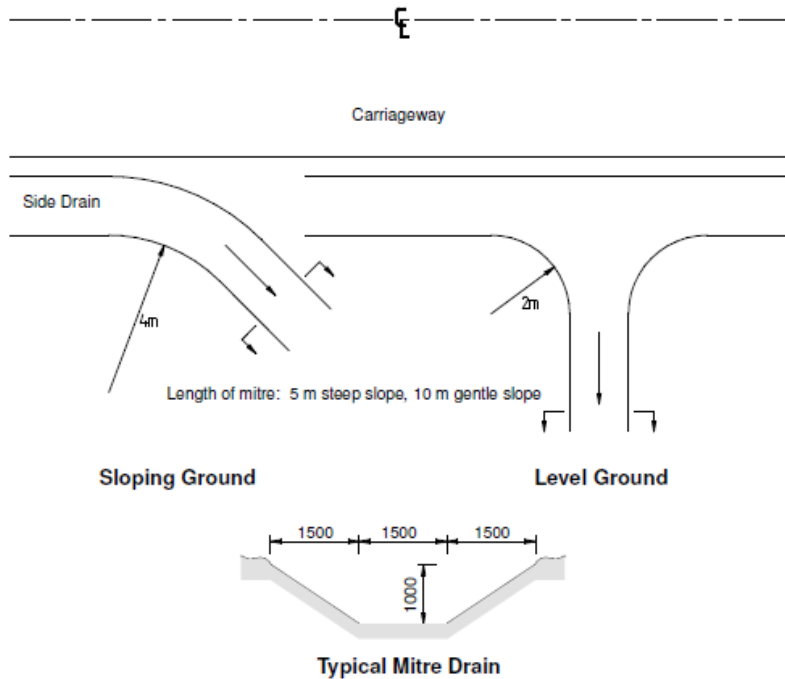


Figure 14:2 Typical Stormwater Mitre Drain / Channel

Gravel roads crossing drainage lines require a suitable sized culvert, concrete causeways or cut-off walls 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, and attenuation storage should be provided on the upstream side of the road crossing.

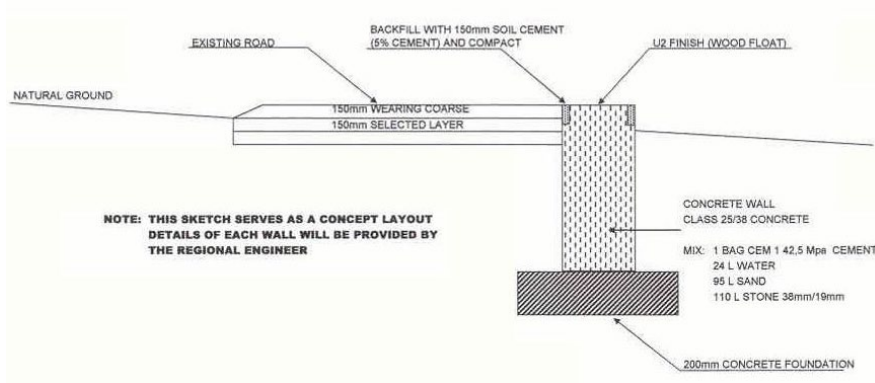


Figure 14:3 Typical Detail of a Cut-Off wall



Figure 14:4 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 14.4**)

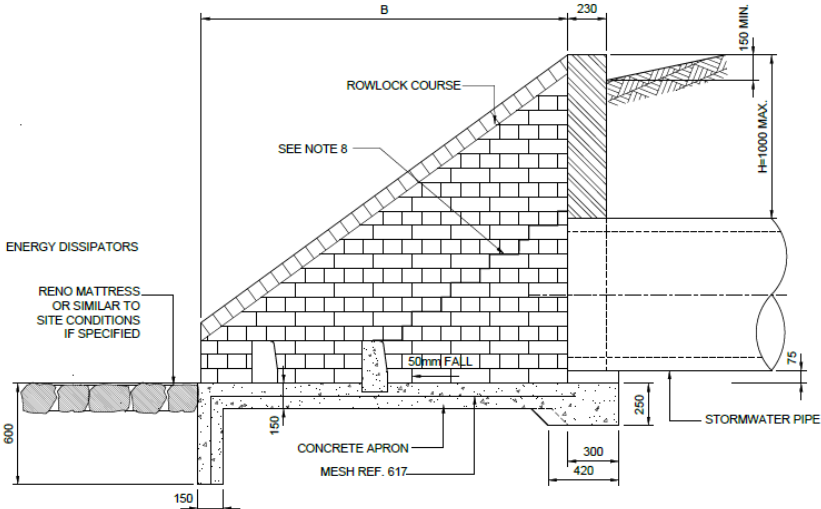


Figure 14:5 Typical Stormwater Headwall with Energy Dissipators

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 deemed necessary and unavoidable. The channels must be suitably lined to prevent erosion and scour and provide maximum possible energy dissipation of the flow. Such linings will 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.

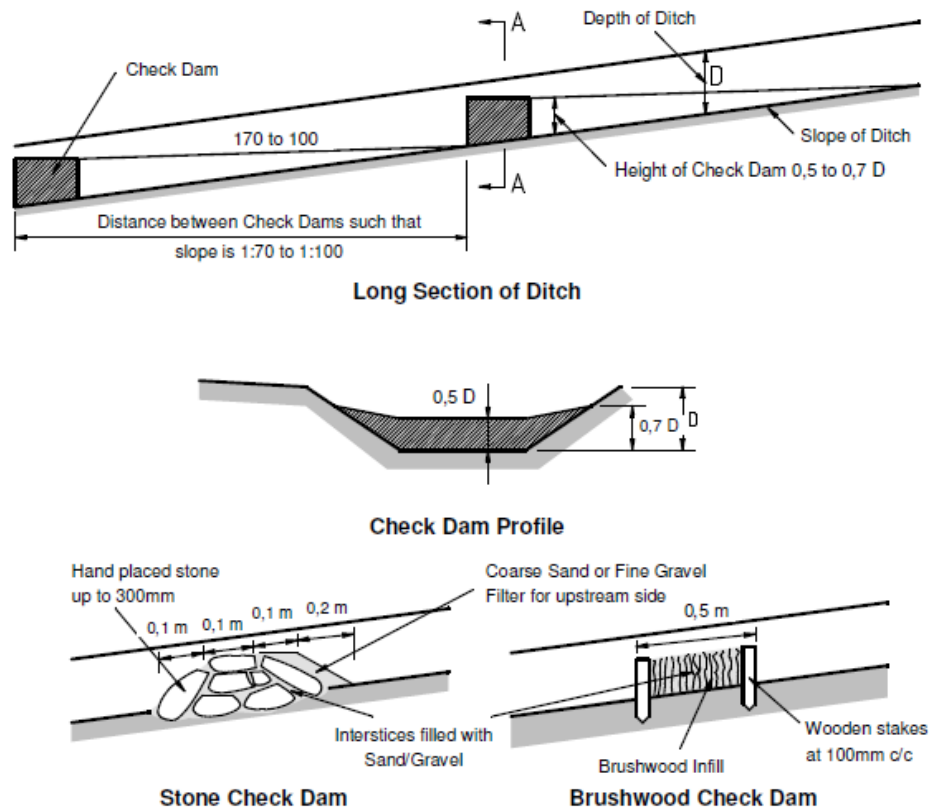


Figure 14:6 Typical Erosion Control

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

The stormwater systems should be free from materials that could harm the water systems' fauna, flora, and aquatic life.

Sites which generate "dirty" (Grey or Black) water must have measures in place that separates the clean and "dirty" water. Depending on the nature of the "dirty" water, the water must either be discharged into the wastewater system or contained on-site for off-site treatment.

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 are to 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 all the provisions, regulations and guidelines in this document 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.
- Appropriate 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 to prevent blockages in the drainage systems.
- 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 binding of soil 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 describing and illustrating the proposed stormwater and erosion control measures during the detailed design phase.
 - 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, it is SiVEST's opinion that the Pofadder WEF 1 and associated grid infrastructure will have a nominal impact on the existing stormwater catchment. The project is therefore deemed acceptable from a stormwater perspective, provided the recommendations and mitigation measures in this report 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 ensure that the requirements and conditions set out in the EMPr are adhered to.

17 REFERENCES

- Climate Data for Cities Worldwide (Pofadder) - www.en.climate-data.org
- Council for Scientific and Industrial Research (CSIR) - *Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology (2003)*
- Lauren M. Cook and Richard H. McCuen – *Hydrologic Response of Solar Farms (May 2013)*
- MJ Gorven, JC Smithers and RE Schulze - *Design Rainfall Estimation in South Africa (Version 3)*
- South African National Botanical Institute – *National Vegetation Map 2012*
- South African National Roads Agency – *Drainage Manual 6th Edition (2013)*
- Bramford, Prof M – *Paleontology. Pofadder WEFs 1,2,3. Pofadder Wind Facility 1 (Pty) Ltd (2022)*
- Weather Atlas (Pofadder) – www.weather-atlas.com
- Western Cape Provincial Administration – *Gravel Roads Manual Rev 0*

APPENDIX A: SPECIALIST CURRICULUM VITAE

CURRICULUM VITAE

Merchandt Le Maitre

Name	Merchandt Le Maitre
Profession	Civil Engineer
Name of Firm	SiVEST SA (Pty) Ltd
Present Appointment	Divisional Manager: Civil Engineering Division
Years with Firm	17 Years
Date of Birth	25 September 1982, Johannesburg, South Africa
ID Number	820925 5037 086
Nationality	South African



Education

- University of Johannesburg (2006)
- University of South Africa (2016)

Professional Qualifications

- N Dip: Civil Engineering
- B Tech: Civil Engineering (Water)
- Pr.Tech.Eng. (Reg. No. 2018300094)

Membership in Professional Societies

- Engineering Council of South Africa (ECSA) – Pr Tech Eng; (Reg N° 2018300094)
- South African Institute of Civil Engineers (SAICE)
- South African Wind Energy Associations (SAWEA)

Employment Record

Nov 2020 – present	SiVEST SA (PTY) LTD: Divisional Manager
May 2004 – Oct 2020	SiVEST SA (PTY) LTD: Senior Civil Engineering Technician
Jan 2004 – April 2004	Con Roux Zambia - Junior Foreman
Dec 2002 – Dec 2003	Neda Engineering - Vacation Work

Language Proficiency

LANGUAGE	SPEAK	READ	WRITE
English	Fluent	Fluent	Fluent
Afrikaans	Fluent	Fluent	Fluent

Years of Working Experience: 17

Countries of Work Experience

- South Africa
- Swaziland
- Zambia
- Kenya
- Namibia

Fields of Expertise

- Bulk Services Studies
- Feasibility Studies
- Service Reports
- Infrastructure Design
- Contract Documentation & Procurement
- Contract Administration
- Procurement and Construction Monitoring

Overview

Merchandt joined SiVEST as a student Civil Engineering Technician in 2004 to which he received a company bursary to complete his studies and join the company permanently thereafter. Since joining permanently he has been actively involved in numerous township projects and associated infrastructure projects.

A summary of the experience in each field is indicated below:

Roads & Stormwater

Design, Implement & Contract Administration:

- Provincial Road Intersections (Class 2 Roads)
- Municipal Roads (Class 3-5 Roads)
- Residential & Industrial Township services
- Bulk Stormwater Infrastructure

Hydrology

- Attenuation Reports
- Flood Inundation Assessments / Floodline Reports
- Stormwater Management Reports
- Stormwater Assessments / Investigations
- Roof Gutter & Down Pipe Design / Assessments / Reports

Water & Sanitation

Design, Implement & Contract Administration:

- Water supply lines including Bulk Water
- Water pump stations
- Sanitation networks including Outfall Sewers
- Sewer pump stations
- Farm Irrigation Network

Renewable Energy

- Transportation Impact Assessments
- Water Demand Assessments
- Glint & Glare Assessments
- Stormwater Management Reports

- Preliminary Engineering Reports & Designs

Projects Experience (by Sector)

TOWNSHIP SERVICES

- Tijger Valley Extension 10, 20, 21, 22, 23, 27, 38-44, 72, 105-113, 19, 62, 103, 104, 34, 35, 36, 123 etc. - Design, Procurement, Contract Administration and Monitoring.
- Derdepoort Extension 181- Design, Procurement, Contract Administration and Monitoring.
- Project Springbok, Sasolburg - Design, Procurement, Contract Administration and Monitoring.
- Arcadia Extension 11 - Design, Procurement, Contract Administration and Monitoring.
- Lakeside Erf 181- Design, Procurement, Contract Administration and Monitoring.
- Longmeadow Extension 10, 11 & 12 - Design, Procurement, Contract Administration and Monitoring.
- Bushwillow Estate - Design, Procurement, Contract Administration and Monitoring.
- Forum Homini – Draughting Monitoring of Dam Spillway construction & sewer reticulation.
- Longmeadow Extension 7, 8, 9, 10, 11, 12 – Township services and design of earth retaining wall.
- Lakeside Erf 181 – Design and supervision of Township Services including Attenuation facilities.
- Mbabane Kingdom Hall – Bulk earthworks and road Design, Procurement, Contract Administration and Monitoring.
- Kungwini Bulk Water – Draughting and supervision of a Steel Bulk Water Supply Pipe.
- Mooikloof Booster Station – Design and supervision of a water booster pump facility..
- PTN 2 of 148 Athol – Compiling and analysis Stormwater Assessment.
- Mooibosch Development – Compiling of Services reports and Floodline Determination.
- Hazeldean Extension 39 – Design and supervision of Township Services.
- Hazeldean Retirement – Design of Township Services.
- Kungwini Collector Sewer – Design of Collector Sewer.
- Maroeladal Extension 9 – Design and compilation of Services Report.
- Hazeldean Oukraal – Design of Township Services
- Hazeldean Business Park – Design and compilation of Services Reports.
- Erf 181 Derdepoort – Design and compilation of Services Reports and preliminary design of Provincial Intersection.
- Erf 92 Edenburg – Floodline Determination and design and compilation of the Services reports.
- Longmeadow Extension 12 Stormwater – Design of Stormwater Reticulation.
- Astral Foods - Design, Procurement, Contract Administration and Monitoring of civil services.
- Eastgate Solar Roof – Glint & Glare Assessment
- Cotton Gin Mpumalanga – Design & Procure all services

ROADS & INTERSECTION DESIGN

- D631 Intersection – Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.
- D36 Intersection & Road Widening - Design, Wayleave Approval, Procurement.
- K34 Intersection – Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.
- K101 Intersection – Design, Wayleave Approval.
- Justice Mahomed, University, Walton Jameson Rd Intersection – Design, Wayleave Approval.
- Cedar Road West – Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.
- Brikor – Design of New Intersection.
- New Zealand Embassy – Design of Intersection.
- East Point Game - Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.

HYDROLOGY AND STORMWATER

- Hazeldean Floodline - Data collection, Flood determination and compilation.

CURRICULUM VITAE

Merchandt Le Maitre

- Gautrain Railway Stormwater Management – Design and compile stormwater management and attenuation facilities.
- Stormwater Modelling for Project Springbok – Attenuation of hazardous material in stormwater system.
- Sappi Ngodwana Floodline – Data collection, Flood determination and compilation. This floodline included cognisance of the Ngodwana dam.
- Irene Mall Stormwater Management - Accommodation of the Post Development stormwater flow through an existing township / suburb.
- Loftus Park Stormwater Management – Accommodation of the Post Development stormwater flow through an existing township / suburb.
- Pienaars River Floodline Modelling – Modelling of the river through two future Class 1 & 3 road bridge structures.
- Renewable Energy Stormwater Management – A number of Management Plans for the Renewable Energy sector has been completed.
- Longmeadow Extension 10 (Pick & Pay) – Design and compilation of Stormwater Management report.
- Erf 4173 Peter Place – Floodline Determination.
- Irene Mall Township – Design of Township Services and Stormwater Management.
- Mitsubishi McCarthy Midrand – Design and compilation of Stormwater Management report.
- Isago @ N12 – Floodline Determination.
- Innoland – Floodline Determination.
- Lot 204 Edenburg – Floodline Determination
- Erf 90 Douglasdale – Floodline Determination.
- PTN 35 Houtkoppen – Floodline Determination.
- Erf 4173 Peter Place – Floodline Determination.
- Hyde Close Floodline – Floodline Determination.
- Chartwell Floodline – Floodline Determination
- Hyundai East Rand – Roof Gutter & Down Pipe design
- Oilifants River – Floodline Determination

WATER TRANSFER / RETICULATION AND SANITATION COLLECTORS / OUTFALLS

- Bojanala Platinum District Municipality – Water & Sanitation Bulk Master Planning.
- Hazeldean Development – Bulk Water Supply & Collector Sewer Design, Procurement, Contract Administration and Monitoring.
- Mamba Kingdom – Bulk Water Analysis.
- Lesedi Local Municipality Bulk Water - Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.
- NEF Tomato Paste Project – Design of Farm Irrigation Network

RENEWABLE ENERGY

- Dyansons Klip 5 – Stormwater Management Report
- De Aar Solar – Stormwater Management Report
- Droogfontein Solar – Stormwater Management Report
- Mierdam Solar – Stormwater Management Report
- Prieska– Stormwater Management Report
- Hoekplaas – Stormwater Management Report
- Noupoort WEF – Stormwater Management Report
- Copperton PV – Stormwater Management Report
- Klipgats PV – Stormwater Management Report
- Tooverberg Wind Energy Facility – Transportation Impact Assessment & Water Demand Assessment
- Umsobomvu Solar Energy - Transportation Impact Assessment
- Prieska Solar Energy - Transportation Impact Assessment Amendment
- Droogfontein Solar Energy - Transportation Impact Assessment Amendment

CURRICULUM VITAE

Merchandt Le Maitre

- Loeriesfontein Solar Energy - Transportation Impact Assessment Amendment
- Koeris WEF - Transportation Impact Assessment Amendment
- East Gate Shopping Centre - Glint & Glare Assessment
- Oya Energy - Glint & Glare Assessment
- Yemaya – Glint & Glare Assessment
- Beaufort West WEF – Preliminary Engineering Design
- Heuweltjies WEF – Transportation Study
- Kraaltjies WEF – Transportation Study
- Koup 1 & 2 – Transportation Study
- Grootegeluk Solar Project – Transportation Study
- Renewstable Swakopmund – Glint & Glare Assessment
- Several projects are Confidential as they are not yet in the public domain and hence have not been included in the list above.

OTHER

- Project Springbok – Design of Services and Railway Siding.
- Phalaborwa Mining Company – Preliminary Design of Bulk Water feed and Railway Line.
- Kansanshi Copper Mine, Zambia – Junior Site Foreman.
- Final QC for Sasol Secunda.
- NDT testing – MMC Nelspruit, Global Forest Products Sabie.
- Boiler inspections and preliminary design – MMC Nelspruit, Global Forest Products, TSB Malelane.

Computer Skills

- AutoCAD Civil 3D
- AutoCAD Storm and Sanitary Analysis
- Microsoft Office
- Microsoft Project
- TechnoCAD
 - Surfmate
 - Roadmate
 - Pipemate
 - Watermate
- AutoTURN (Vehicle Turning Simulation Software)
- RiverCAD
- HecRAS
 - 1D Flood Modelling
 - 2D Flood Modelling

A handwritten signature in black ink, appearing to read "W. Maitre".



SIVEST Civil Engineering Division

Building A, Loftus Park
417 Kirkness Street, ARCADIA
Pretoria, 0007
Gauteng
South Africa

Tel + 27 11 798 0600
Fax +27 11 803 7272

Email info@sivest.co.za
www.sivest.co.za

Contact Person: Merchandt Le Maitre
Email: merchandtm@sivest.co.za