

# TECHNICAL MEMORANDUM

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To: P Van Deventer  
From: E-TEK Consulting  
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## REPORT:

### SPECIALIST STUDY: HYDROLOGY AND STORMWATER MANAGEMENT PLAN FOR VINTAGE ENERGY (PTY) LTD

## CONTENTS

1. Declaration.....	2
2. Terms of Reference.....	2
3. Legislative Requirements.....	3
4. Regional Description.....	4
5. Rainfall Data.....	4
6. Surface Water Hydrology.....	4
7. Flood Peaks.....	5
8. Floodlines and 100m exclusion zones.....	5
9. Summary and Recommendations.....	8
10. Disclaimer.....	9

## TABLES

Table 1: Adopted design rainfall for the site .....	4
Table 2: Catchment characteristics .....	5
Table 3: Flood peaks for various return periods (m <sup>3</sup> /s) .....	5
Table 4: Adopted flood peak for different river reaches .....	6
Table 5: Profile output table .....	7

## APPENDICES

APPENDIX A: Quaternary Catchments .....	10
APPENDIX B: Rainfall and Stream Flow Stations .....	11
APPENDIX C: Vegetation .....	12
APPENDIX D: Contributing Catchments (Aerial View) .....	13
APPENDIX E: Contributing Catchments (Raster Image) .....	14
APPENDIX F: 100 Year Flood Lines and 100m Exclusion Zone boundaries (Google image backdrop) .....	15
APPENDIX G: 100 Year Flood Lines and 100m Exclusion Zone (1:50 000 Raster image backdrop) .....	16

## 1. DECLARATIONS

### INDEPENDENCE

E-TEK Consulting (Pty) Ltd (E-TEK) hereby declares that it is an independent consulting company in that it has no business, financial, personal or other interest in this project in respect of which E-TEK is appointed. Furthermore, no circumstances exist that may compromise the objectivity of E-TEK, excluding fair remuneration for work performed in connection with this surface water management plan.

### COMPETENCE OF PROJECT TEAM

- PM Harris (B.Sc. Eng (Agric) has been practicing in the field of environmental management and engineering for the past 17 years. The focus area in his career has been the compilation and implementation of closure, rehabilitation and stormwater management plans.
- P Vlok (B. Tech Engineering Civil), (B.Sc. (Water Resources)), (Pr. Tech Eng) has been practicing in the field of construction management and engineering for the past 11 years. His focus area is the design and implementation of stormwater management plans.

## 2. TERMS OF REFERENCE

Vintage Energy (Pty) Ltd ("VE"). is seeking from Regional Council a Development Permit for Change of Use and Reconfiguration of a Lot (Division of Land by Agreement) to permit the establishment and operations of a **photovoltaic (PV) Solar project**. (Project).

The proposed site is situated on the farm Brypaal 134 located between the local municipality of Kai Garib and District municipality of ZF Mgwacu, Northern Cape, South Africa. The project area, of 1 045 ha, is located 70 kilometres southwest of the town Kakamas. (Site centre coordinates 29° 11.895'S 20° 23.228'E).

As part of an environmental impact assessment (EIA) process, a specialist study relating to the hydrology of the site is required. This includes a stormwater management plan (SWMP), the floodlines and exclusion zones of the drainage lines in close proximity to the site.

The legislative requirements that the SWMP need to comply with are detailed in paragraph (§) 3 of this document, of which the following regulations cited in the regulations of Government Notice 704 (GN 704) of the National Water Act and Operational Guideline No. M6.1 are of note:

- Regulation 4: Restrictions on locality
- Regulation 7: Protection of water resources

E-TEK Consulting was also appointed for the following:

- Calculating the flood peaks and delineating the floodlines for a 1:100 yr storm event
- Compiling a specialist study report describing the following:
  - Hydrology of the site
  - Stormwater management plan for the site

### 3. LEGISLATIVE REQUIREMENTS

The following legislation and guidelines were considered as relevant to this type of project ( Figure 1).

- National Water Act (NWA) Act 36 of 1998 and its regulations with specific reference to the requirements of the Department of Water Affairs and Forestry (DWAF) Government Notice No. 704 (GN704), *Guideline Document for the Implementation of Regulations on Water Use of Mining and Related Activities Aimed at the Protection of Water Resources*.
- National Environmental Management: Waste Act (NEM:WA)
- National Environmental Management Act (NEMA) Act 107 of 1998 and its regulations.

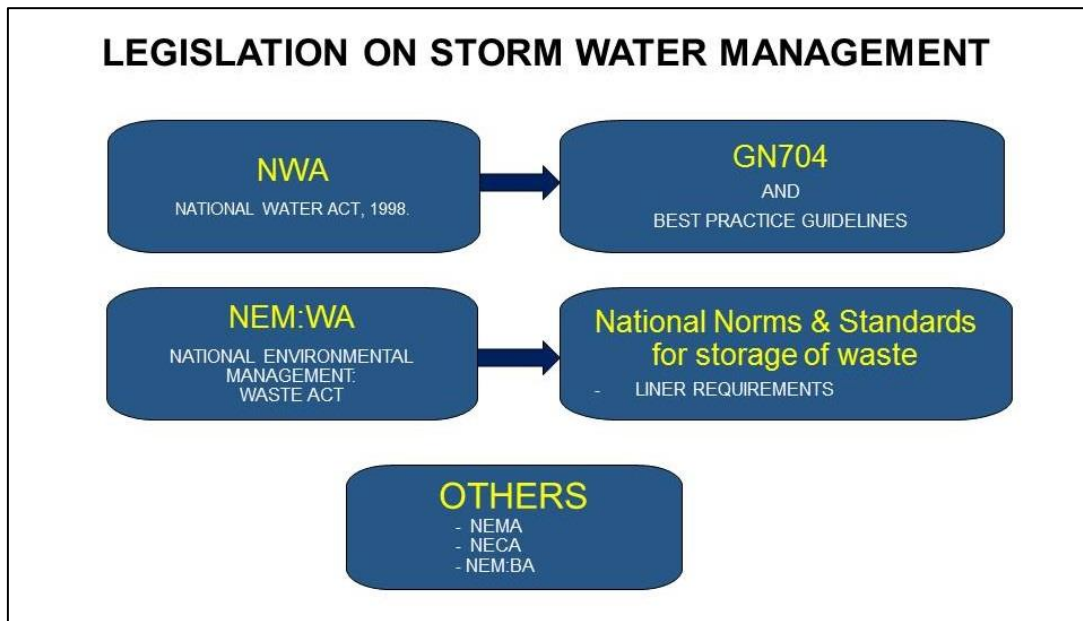


Figure 1: Schematic diagram of stormwater management legislation

Special attention is drawn to the following Regulations within GN704 of the NWA:

#### 3.1. Applicable extracts from GN704

##### 3.1.1. Regulation 4: Restrictions on locality

No person in control of a mine or activity may-

- (a) *locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;*

##### 3.1.2. Regulation 7. Protection of water resources.

*Every person in control of a mine or activity must take reasonable measures to*

- a) *prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the Act;*

*b) design, modify, locate, construct and maintain all water systems, including residue deposits, in any area so as to prevent the pollution of any water resource through the operation or use thereof and to restrict the possibility of damage to the riparian or in-stream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics;*

*h) cause all domestic waste, including wash-water, which cannot be disposed of in a municipal sewage system, to be disposed of in terms of an authorisation under the Act.*

#### 4. REGIONAL DESCRIPTION

The Brypaal Solar Farm area is situated in the quaternary catchment D53H (APPENDIX A), approximately 60 km south of Kakamas, in the Kai Garib Local Municipality of the Northern Cape. The perennial river in the project area, namely the Orange River, flows to the west. The non-perennial river in the project area, namely the Sout River, closest to the site, flows in a north-eastern direction before flowing into the Hartbees river, a tributary of the Orange River. (APPENDIX B).

The area is characterised with relatively flat areas with minor variation of approximately twenty metres across the site with a maximum elevation of 881 m above sea level.

The site vegetation according the Water Resources of South Africa 2012 (WR2012) is depicted in APPENDIX C of which the predominant veld type is Karoo and Karroid types.

#### 5. RAINFALL DATA

Rainfall data is available from Weather Station 0249594\_W located approximately 24 km South of the proposed solar project. The station has a 34-year record. **The mean annual precipitation for the weather station is 133 mm.**

#### 6. SURFACE WATER HYDROLOGY

Design rainfall volumes for different return periods are indicated in Table 1.

**Table 1: Adopted design rainfall for the site**

Duration	Return Period Rainfall (mm) (1:x years)						
	2	5	10	20	50	100	200
24 hour	31	49	62	75	94	111	128
1 day	28	44	56	68	85	100	115
2 day	35	56	71	87	108	126	145
3 day	37	59	76	93	117	136	157
7 day	40	64	83	102	130	153	178

The catchment characteristics of the two sub-catchments delineated for the project are presented in Table 2. Refer to APPENDIX D and APPENDIX E for the delineated catchment areas.

**Table 2: Catchment characteristics**

No.	Catchment Description	Area (km <sup>2</sup> )	Longest watercourse (km)	10-85 slopes (m/m)	Time of concentration (hrs)
1	Catchment A	35.13	13.09	0.006	3.46
2	Catchment B&C	4.87	4.38	0.009	1.29
3	Catchment C	1.77	3.19	0.008	1.02
4	Catchment D	0.67	1.69	0.009	0.5

## 7. FLOOD PEAKS

The flood peaks for the Project area were determined using the Standard Design Flood Method (SDF). The SDF is widely used in South Africa for any catchment size and is easy to apply. The flood peaks for the project area are depicted in Table 3.

**Table 3: Flood peaks for various return periods (m<sup>3</sup>/s)**

No.	Catchment Name	Return period (years)						
		2	5	10	20	50	100	200
A.	Catchment A	4	13	20	29	41	50	62
B.	Catchment B&C	1	4	6	9	12	15	19
C.	Catchment C	1	2	3	4	6	7	8
D.	Catchment D	1	1	2	2	3	4	5

## 8. FLOODLINES AND 100M EXCLUSION ZONES

Refer to APPENDIX F and APPENDIX G which indicate the positions of the 100-year floodlines and 100m exclusion zones.

A flood assessment was undertaken for the non-perennial rivers to determine the 1:100-year floodlines in the proximity of the Brypaal Solar Project.

The floodlines were calculated using the HEC-RAS model, which determines the flood levels for various peak flows using standard Manning's based hydraulic equations. The input required to run the model includes:

- Cross sectional data which were obtained from GIS software (Global Mapper)
- "Roughness" of the watercourse with an adopted Manning's number of 0.06
- Peak flow data using the SDF Method

The river analysis where divided into three river reaches (Refer to Table 4)

**Table 4: Adopted flood peak for different river reaches**

Reach Name	Reach 1:100-year peak flood (m <sup>3</sup> /s)
River A	50
River B	15
River C	7
River D	4

The following can be derived from the exercise:

- The project area only affects "River B", "River C" and "River D". Only River B and D appear on the 1:50 000 raster maps<sup>1</sup>(Refer to APPENDIX F and APPENDIX G and indicated as a "drainage line"
- River C appears to be a visible stream as depicted in APPENDIX F and was analysed to verify flow depths and velocities (refer to Table 5)
- The flow velocities in river C appears to be less than 1 m/s
- The deepest flow depth is 0.49m and all infrastructure in the reach should be constructed 0.8m above the lowest channel level at each section crossing the reach
- The project does not impact on the downstream users or the catchment yield
- River D is negligibly small but appears on the 1:50 000 raster maps, thus analysed

<sup>1</sup> Supplied by the Chief Directorate of Surveys and Mapping

**Table 5: Profile output table**

Reach	River station	Minimum channel elevation (m)	Water surface elevation (m)	Flow depth (m)	Channel velocity (m/s)
River C	1509.25	877.88	878.05	0.17	0.46
River C	1410.03	877.2	877.42	0.22	0.3
River C	1309.26	876.14	876.28	0.14	0.9
River C	1209.49	875.41	875.72	0.31	0.23
River C	1109.49	875.07	875.18	0.11	0.85
River C	1009.49	873.27	873.73	0.46	0.34
River C	920.15	873.01	873.45	0.44	0.41
River C	820.15	872.19	872.46	0.27	0.85
River C	720.15	870.78	871.02	0.24	0.39
River C	620.15	869.66	869.86	0.2	0.54
River C	510.12	868.69	869	0.31	0.36
River C	400	868	868.32	0.32	0.5
River C	300	867.13	867.62	0.49	0.48
River C	200	866.8	867.19	0.39	0.3
River C	100	866.49	866.8	0.31	0.34
River C	0	865.91	866.2	0.29	0.48

## 9. SUMMARY AND RECOMMENDATIONS

### 9.1. Summary of observations:

- The 100-m exclusion zone (100m from the drainage line centre line) is wider than the 100 yr floodline crossing the project site
- The maximum flow depth in the drainage line during a 1:100-year flood event is approximately 0.5 m deep
- The flow velocity in the drainage line during a 1:100 yr storm event is less than 1m per second

### 9.2. Recommendations:

- Apply for exemption of Reg 4 of GN 704 (Figure 2) to allow construction of the solar panels within the 100m exclusion zone agreeing to the following mitigation measures:
- Move the laydown area 170m in a north eastern direction as depicted. (Refer to APPENDIX F and APPENDIX G.)

Regulation 4: Restrictions on locality

No person in control of a mine or activity may-

(a) ..... or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse .....

**Figure 2: Extract: Regulation 4 of GN 704.**

### 9.3. Mitigation:

- All horizontal structures will be constructed higher than 0.5 m above the deepest point of any drainage line.
- Plinths or vertical risers supporting the PV cells will be placed as far as possible from the centreline of the drainage line – equidistant from the centre line
- No concentration of runoff may result from the infrastructure
- All roads / access routes will be monitored to prevent concentration of runoff
- All waste and oil spills need to be managed during the construction, operational and decommissioning phases.



## **10. DISCLAIMER**

This report has been produced by E-TEK Consulting (Pty) Ltd., (hereafter “E-TEK”) with the skill and care ordinarily exercised by a reasonable Environmental Consultant at the time the services were performed. Further, and in particular, the Services were performed by E-TEK taking into account the limits of the scope of works required by the Client, the time scale involved and the resources, including financial and manpower resources.

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E-TEK hereby disclaims any responsibility to the Client and others in respect of any matters outside the scope of work as agreed in the relevant proposal.

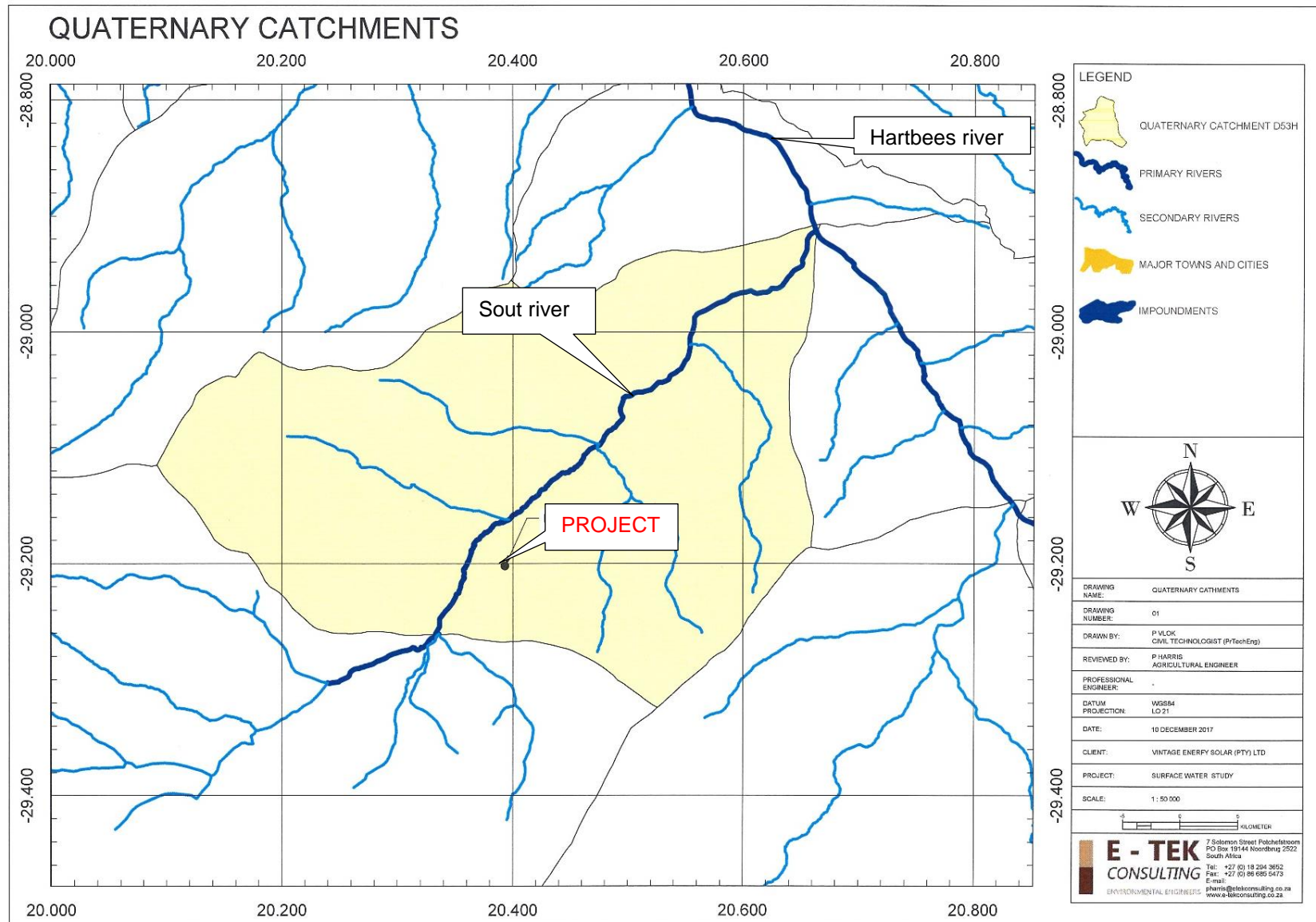
None of the work performed during this project shall constitute or be represented as a legal opinion of any kind or nature, but shall be a representation of the findings.

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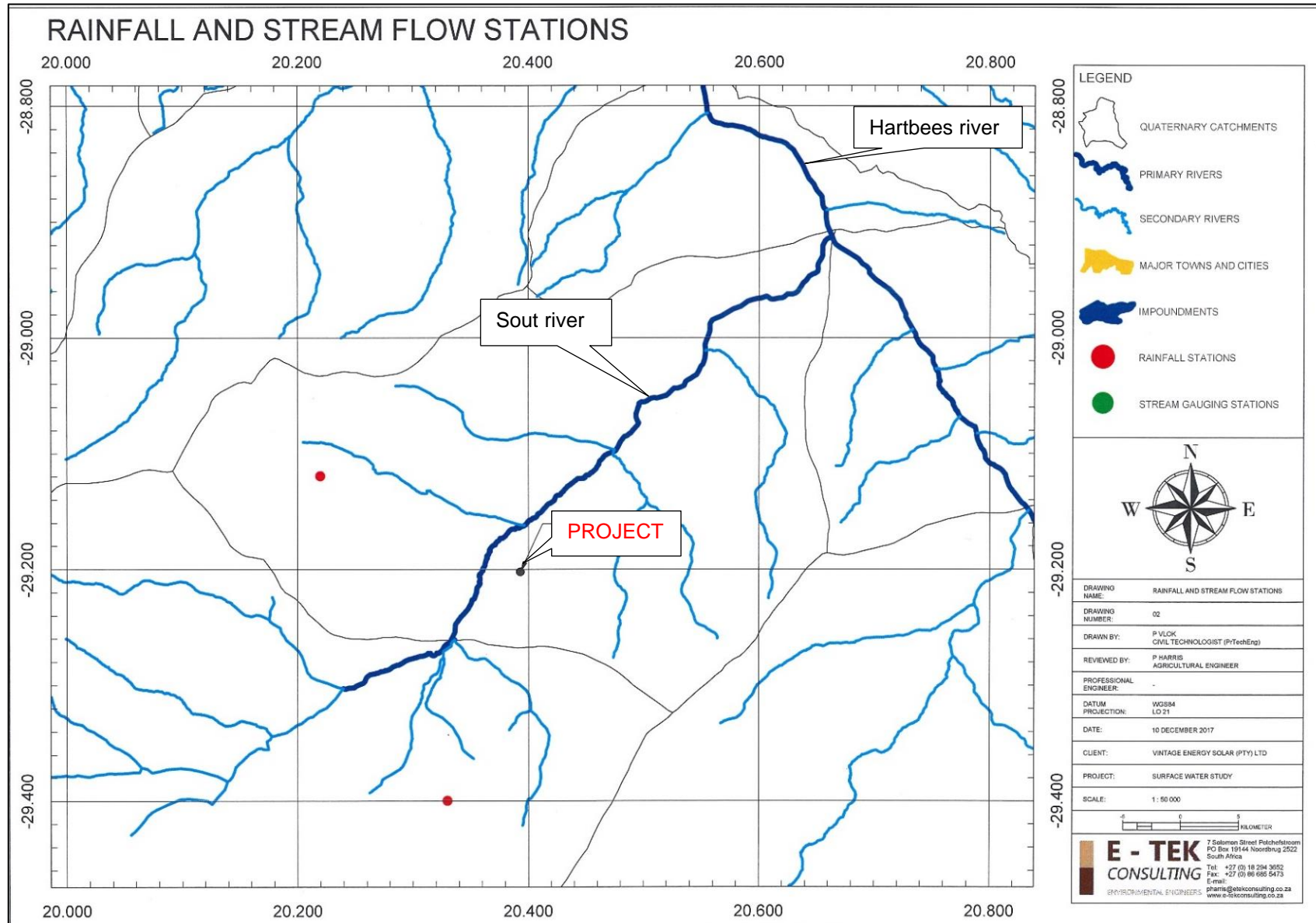
Any reference to legislation in this report should not be perceived as a substitute for the provisions of such legislation. In the event of any inconsistency between this document and such legislation, the latter would prevail.

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

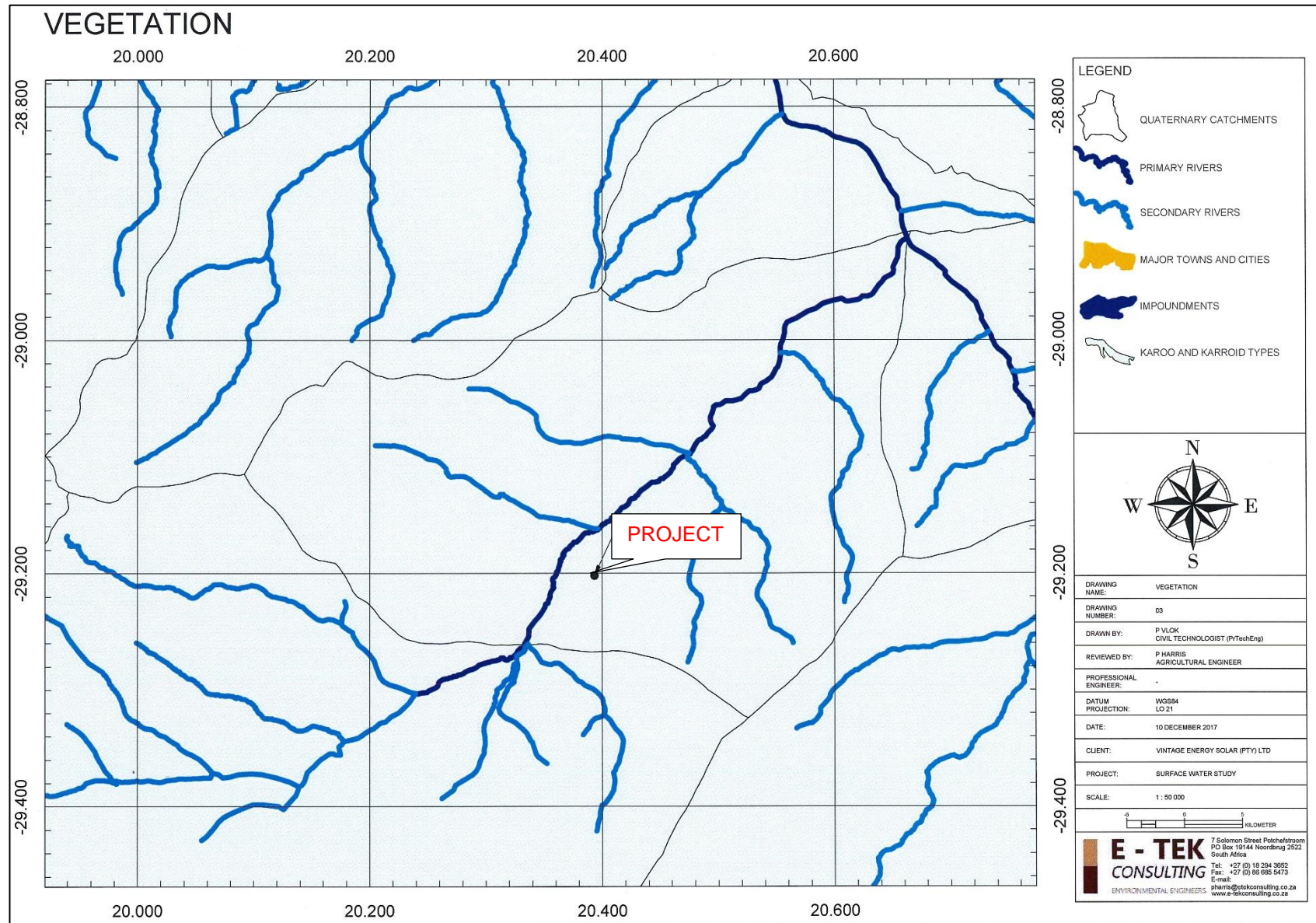
**APPENDIX A: Quaternary Catchments**



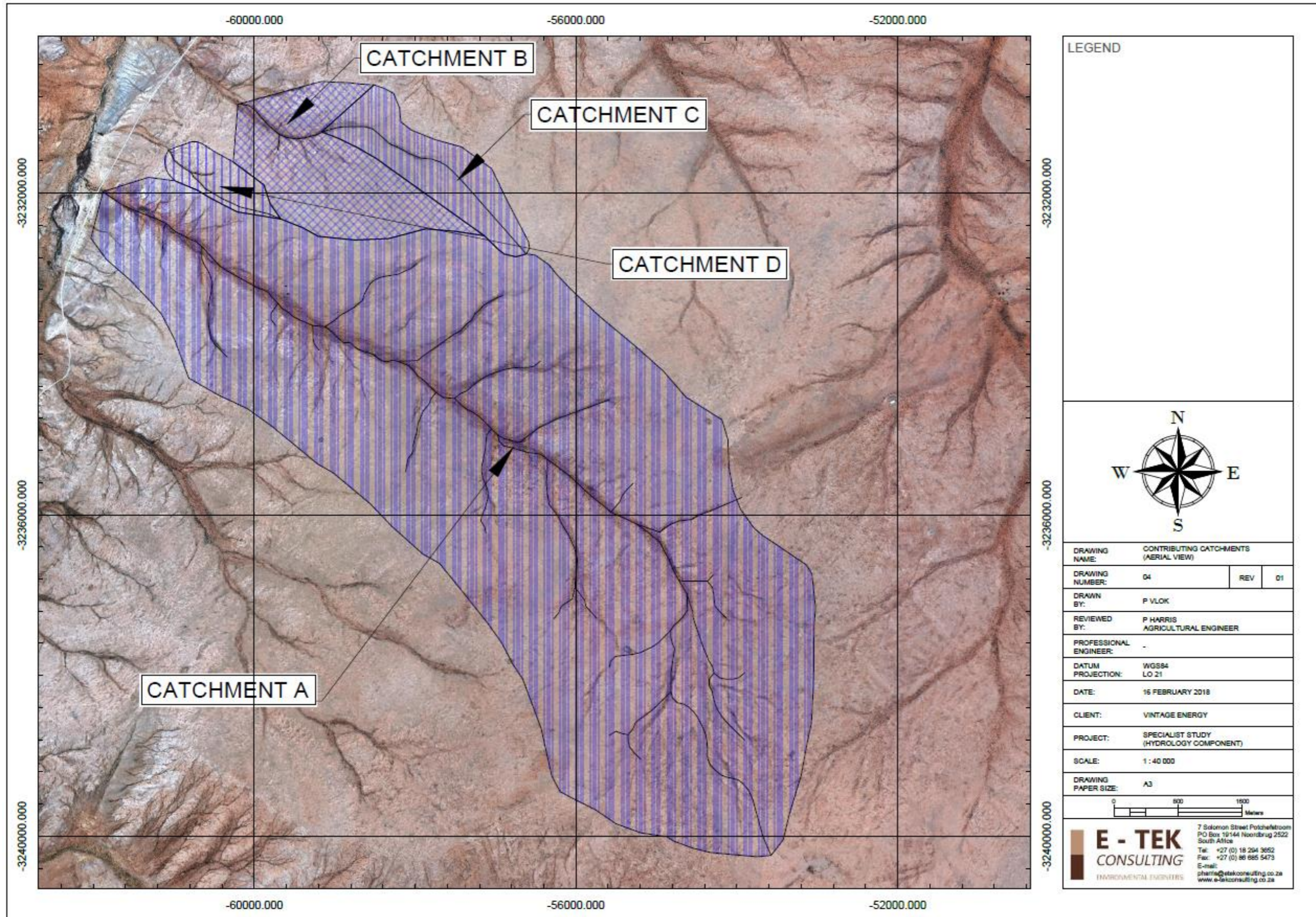
**APPENDIX B: Rainfall and Stream Flow Stations**



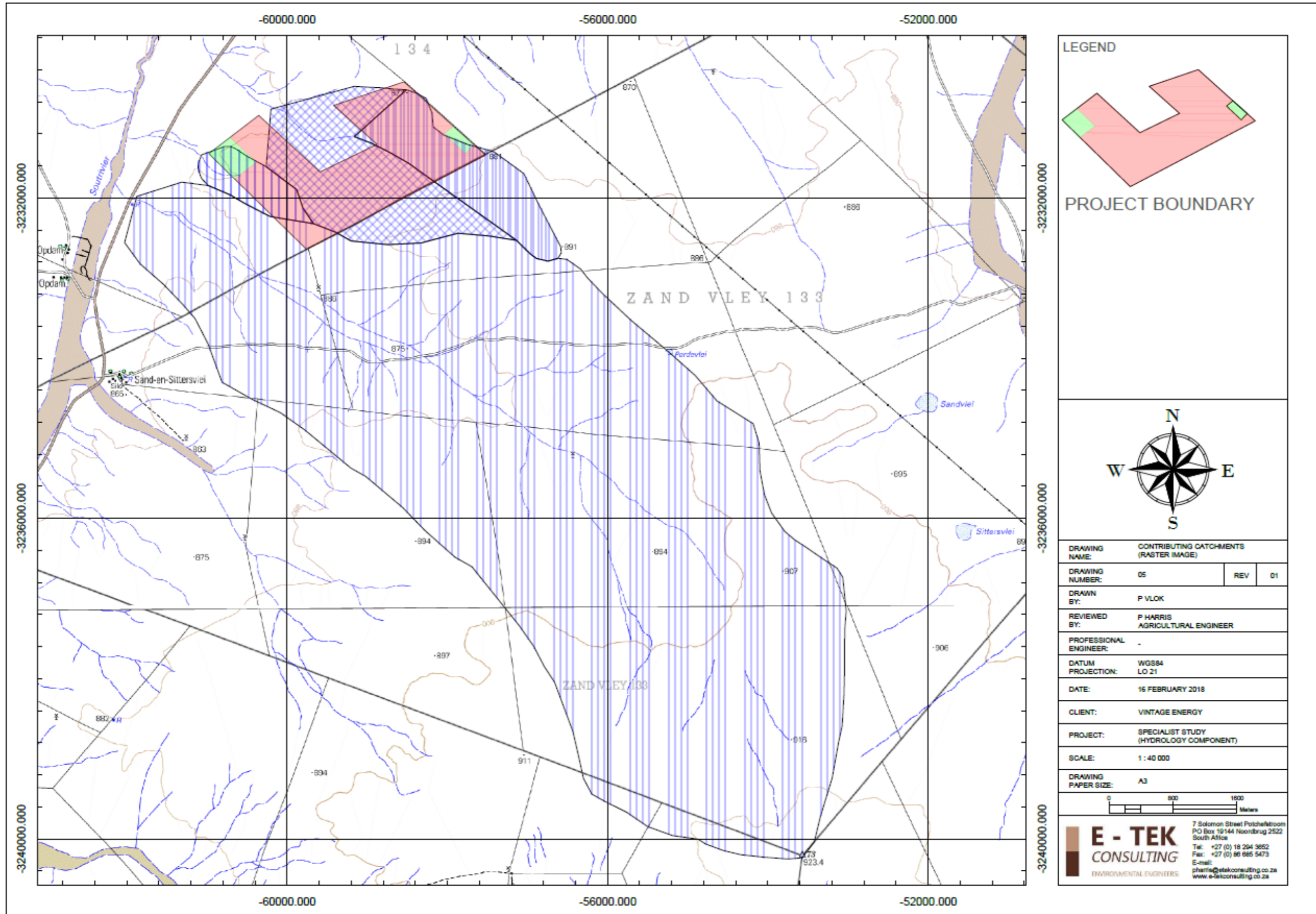
**APPENDIX C: Vegetation**



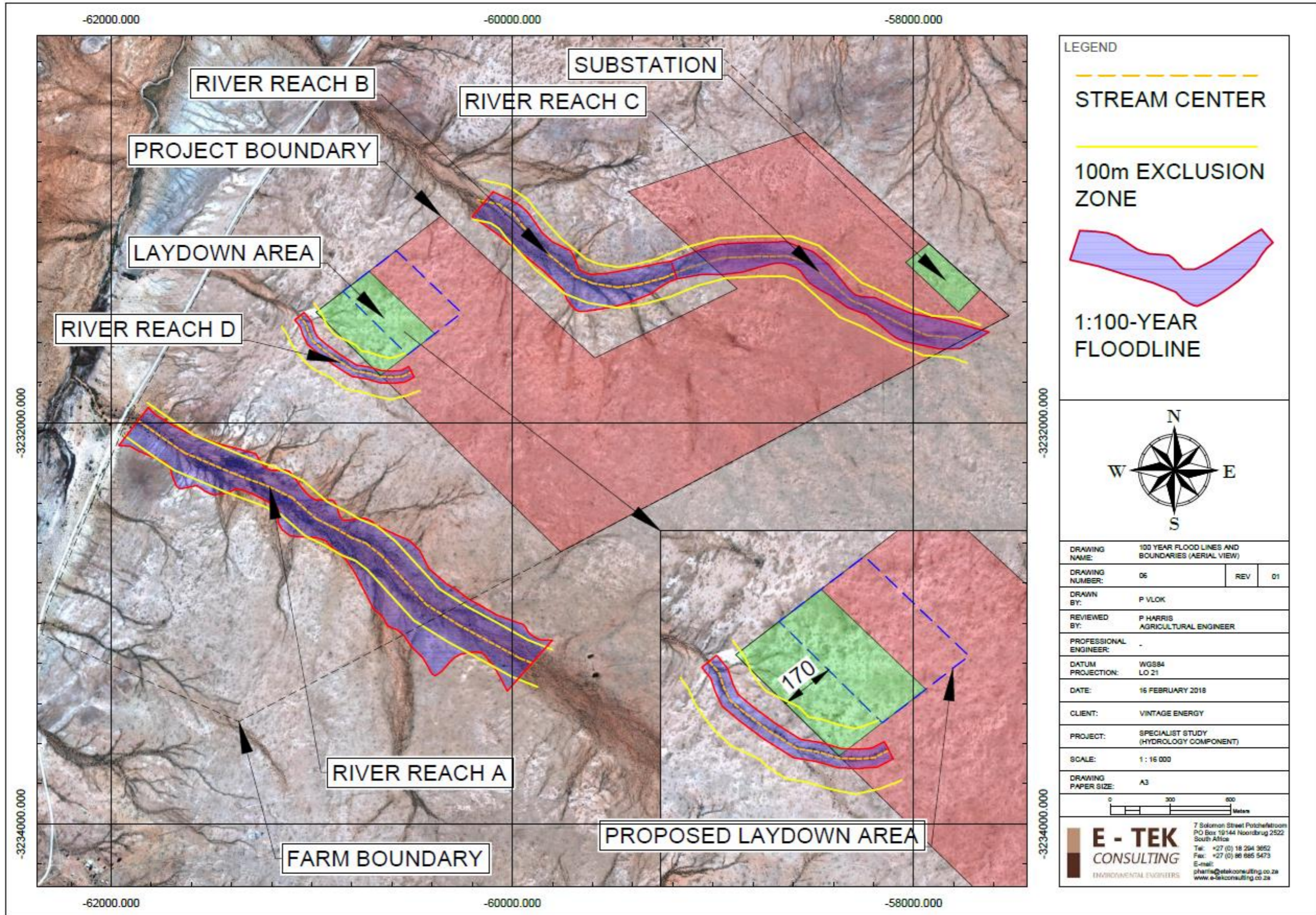
APPENDIX D: Contributing Catchments (Aerial View)



APPENDIX E: Contributing Catchments (Raster Image)



APPENDIX F: 100 Year Flood Lines and 100m Exclusion Zone boundaries (Google image backdrop)



APPENDIX G: 100 Year Flood Lines and 100m Exclusion Zone (1:50 000 Raster image backdrop)

