PROPOSED TOWNSHIP, GEMSBOKSPRUIT TOWNSHIP ESTABLISHMENT SITUATED PORTION 4, 5, 13, REMAINDER OF PORTION 12 OF THE FARM GEMSBOKSPRUIT 229 JR, MPUMALANGA PROVINCE

1:100 RETURN PERIOD FLOODLINE DETERMINATION REPORT

MAY 2021, Rev 0

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Contents

List of tables

List of Figures

1.0 INTRODUCTION

1.1 Study Request

Dalimede Projects (PTY) LTD was appointed by Nkanivo Development Consultants to undertake floodline assessment relating to the proposed Gemsbokspruit township establishment situated portion 4, 5, 13, remainder of portion 12 of the Farm Gemsbokspruit 229 JR, Mpumalanga Province.

1.2 Locality

The proposed township is situated in Gemsbokspruit, 90km north-east of Pretoria along the R573 Moloto road. The area is administered by Thembisile Hani Local Municipality, under the Nkangala District Municipality. GPS coordinates of site are 25°24'13.15"S 28°54'15.91"E.

The locality map is shown on the figures below.

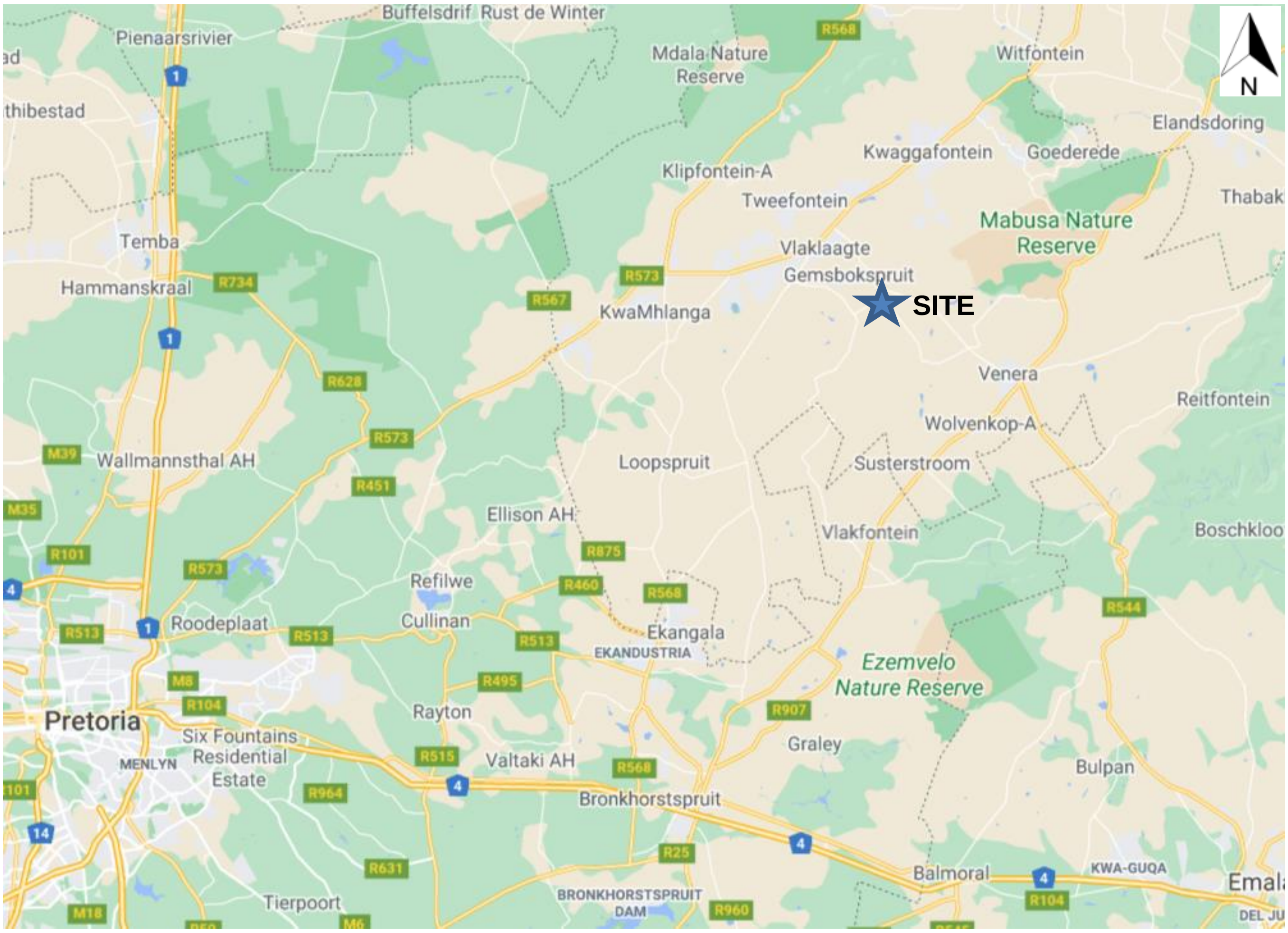

Figure 1 Location of development site

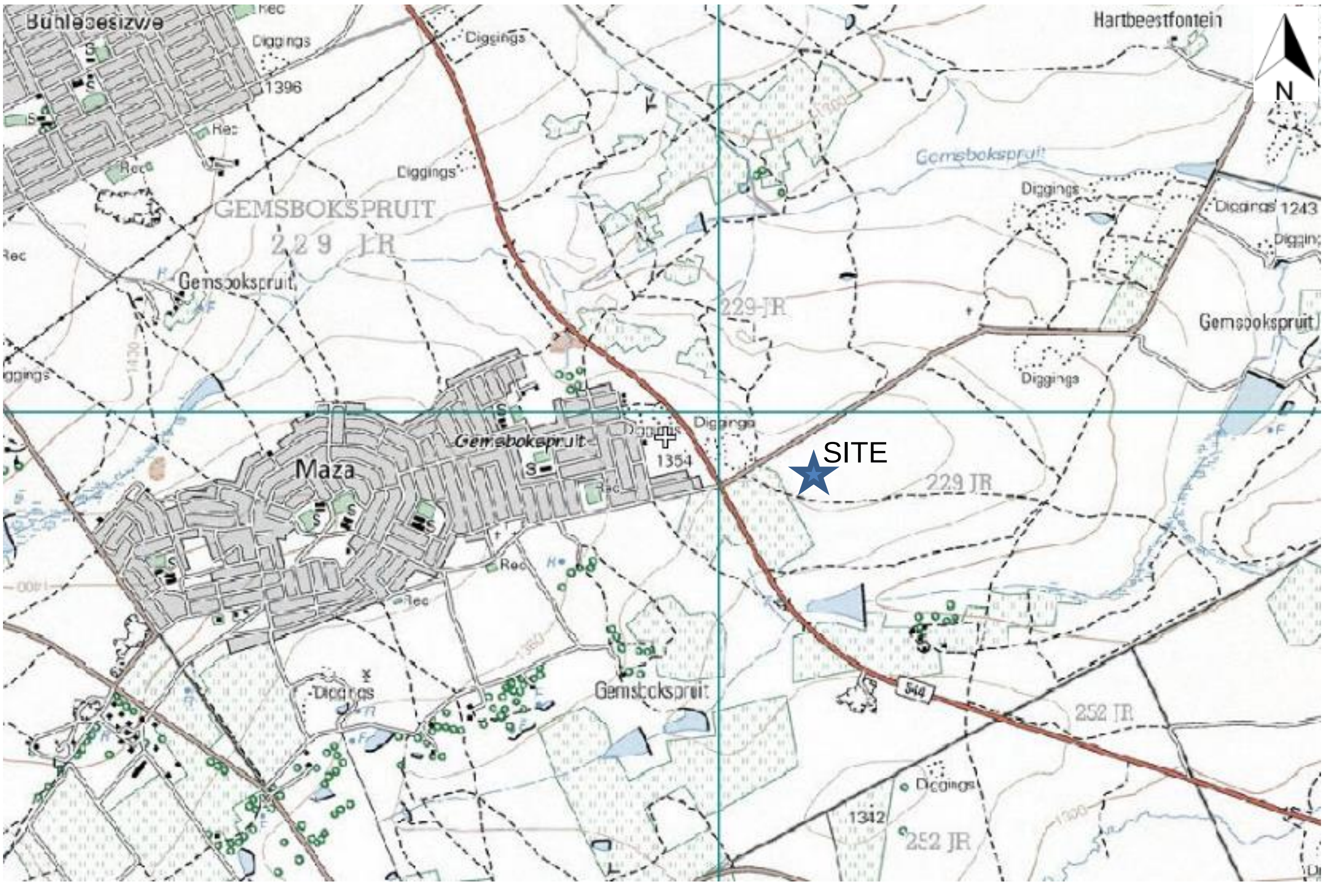

Figure 2 Project site

1.3 Background

A flood line analysis must be conducted along the stream / river traversing or in proximity of the site of proposed development.

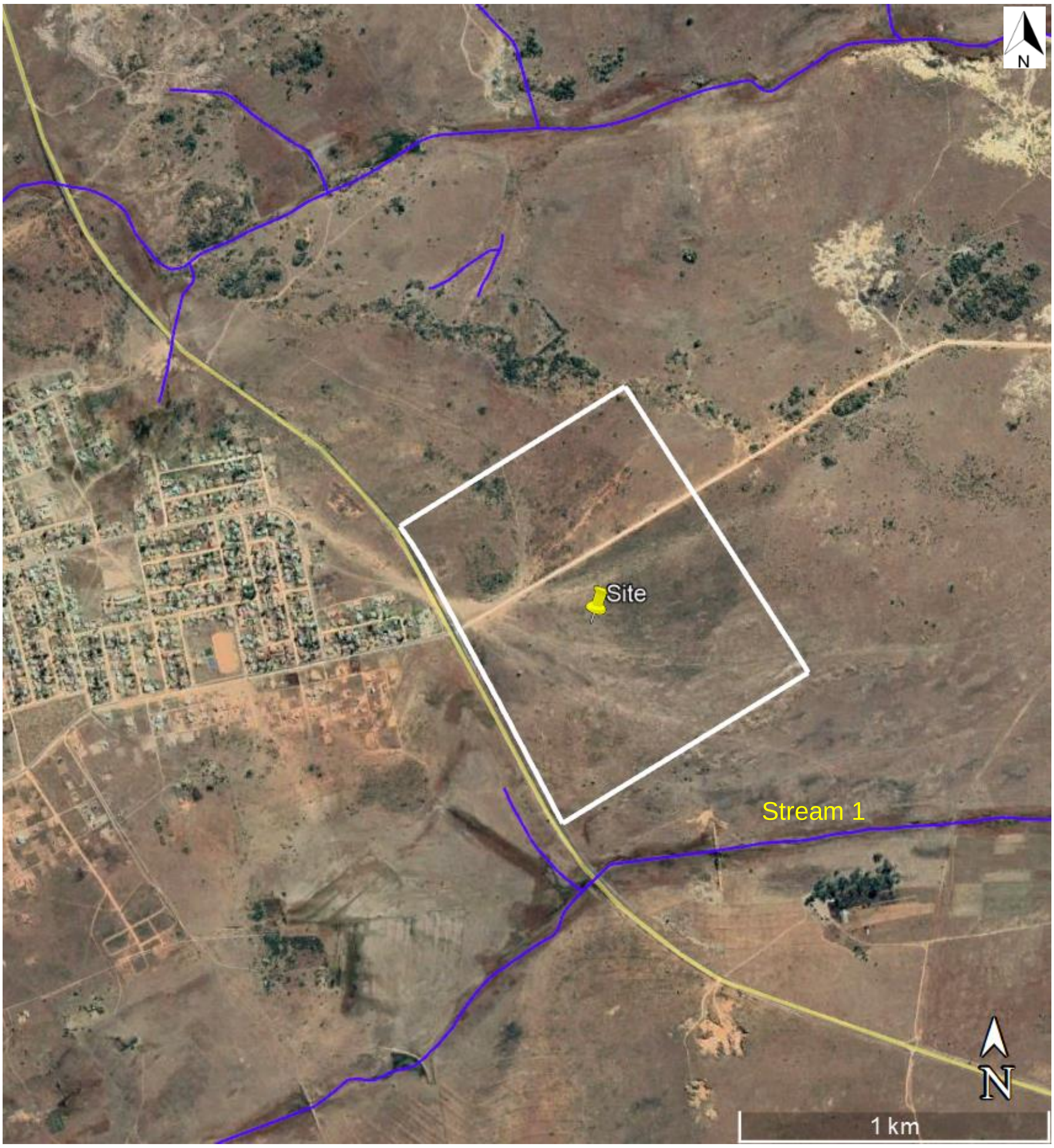

Figure 3 Streams


Figure 4 Stream 1 onsite

1.4 Methodology

1.4.1 general

The study consists of 2 major components:

- a flood analysis to determine the flood peak flow and,
- a surface water profile analysis to determine the flood line.

The magnitude of a flood is dependent on many factors, such as catchment size, slope and rainfall intensity. There are several different methods for determining floods and in general, different methods arrive at different estimates of the peak flow rate. The accepted approach is therefore to use several methods and then make a judgment call as to which method is the most applicable to the catchment under consideration. For this study, the Rational, Alternative Rational, Standard Design Flood (SDF) methods were used to determine the peak flow rate for the 1:100 return flood.

The reason for choosing these methods was because they are applicable to the catchment and to show the variance in the flood line between the method that produced the highest flood peak and the method that produced the lowest flood peak. Hence a flood line has been produced to take cognisance of the uncertainty related to estimating floods and flood lines.

The area of the catchment in which the adjacent stream is located was determined using GIS software as were additional properties applicable to the catchment, such as the length of the watercourse and the centroid of the catchment. The flood peak flows provide the flow used in the flood line analysis using the *HEC-RAS* software.

Other input required for *HEC-RAS* is channel geometry and roughness parameters.

Channel cross-sections were taken at points along the river / stream course, within the area that contour lines were provided. The stream reaches that were analysed are in a natural state. See the figure below for the streams in catchment area.

1.4.2 Flood Modelling Methodology

Flood peaks for the catchments selected for flood modelling were estimated by the following methods using the Utility Programs for Drainage (UPD) software, 2007 with the methods detailed in SANRAL, 2013:

- Rational Method (RM).
- Alternative Rational Method (ARM).
- Standard Design Flood (SDF).

1.4.2.1 Rational Method

This method is based on the conservation of mass and is applicable for catchment areas below 15 km^2. Aerial and time distributions of rainfall in this method are assumed to be uniform throughout the catchment. Flood peaks and empirical hydrographs can be determined by this method.

Where: The peak flow is obtained from the following relationship:

$$Q = \frac{CIA}{3.6}$$

Where: Q = peak flow (m^3 /s)
C = runoff coefficient (dimensionless)
I = average rainfall intensity over the catchment (mm/hour)
A = effective runoff area of the catchment (km^2)
3.6 = conversion factor

1.4.2.2 Alternative Rational Method

This method is based on the rational method with the point precipitation being adjusted using the Design Rainfall Estimation Methodology developed by Smithers and Schulze (2003) to consider local South African conditions.

Design rainfall values for the study area were extracted from the database of six closest to site South African Weather Service stations, using the Design Rainfall Utility developed by Smithers and Schulze (2000).

Table 1 Design Rainfall Values for the site

Duration		Return Period (Years) Design Rainfall Depth (mm)						
		1:2	1:5	1:10	1:20	1:50	1:100	1:200
5	m	8.8	12.2	14.7	17.5	21.4	24.7	28.4
10	m	13.1	18.1	21.9	25.9	31.8	36.7	42.1
15	m	16.5	22.8	27.6	32.7	40	46.2	53.1
30	m	20.9	28.9	34.9	41.3	50.7	58.5	67.2
45	m	24	33.2	40.1	47.5	58.2	67.2	77.1
1	h	26.5	36.6	44.2	52.3	64.2	74.1	85.1
1.5	h	30.4	42	50.8	60.1	73.7	85.1	97.6
2	h	33.5	46.3	56	66.3	81.3	93.8	107.7
4	h	39	53.9	65.1	77.1	94.5	109.2	125.3
6	h	42.6	58.9	71.2	84.2	103.3	119.3	136.9
8	h	45.4	62.7	75.8	89.7	110	127	145.7
10	h	47.7	65.8	79.6	94.2	115.5	133.4	153
12	h	49.6	68.5	82.8	98	120.2	138.8	159.2
16	h	52.8	72.9	88.2	104.4	128	147.8	169.6
20	h	55.5	76.6	92.6	109.6	134.4	155.1	178
24	h	57.7	79.7	96.3	114	139.8	161.5	185.3
1	d	48	66.3	80.1	94.8	116.3	134.3	154.1
2	d	59	81.4	98.5	116.5	142.9	165	189.3
3	d	66.5	91.9	111.1	131.5	161.2	186.2	213.6
4	d	72	99.4	120.2	142.3	174.5	201.5	231.2
5	d	76.6	105.7	127.8	151.3	185.5	214.3	245.9
6	d	80.5	111.2	134.4	159.1	195.1	225.3	258.5
7	d	84	116	140.2	166	203.5	235	269.7

2.0 PROPOSED DEVELOPMENT

2.1 Flood Analysis

To make the analysis possible, properties of the catchments that influence the runoff relating to the 1:100 return flood event need to be determined. These properties are described in the following sections.

2.1.1 Catchment Properties

The catchment topography is composed of mainly flat areas. The topographic elevation ranges from 1290m to 1420m above sea level. The landscape soils are mostly with slow infiltration rates with restricted permeability (Schulze, 2010). The soils are classified to have a moderately high runoff potential.

The Mean Annual Precipitation (MAP) of the catchment was determined from weather stations gridded from in the vicinity of the site. The MAP for the catchment is estimated to be 668mm.

Table 2 Rainfall data

Station Name	**SAWS**	**Distance**	**Record**	**Latitude**		**Longitude**		**MAP**
	Number	(km)	(Years)	(°)	(')	(°)	(')	(mm)
Kwaggafontein	0551769_W	9.7	26	25	19	28	56	669
Verena-Pol	0552029_W	15.5	27	25	29	29	1	668
Zustershoek-Pol	0551386_W	19.9	30	25	25	28	43	606
Enkeldoorn-Pol	0551354_W	21.6	54	25	24	28	42	600
Hawerspruit	0514452_W	22	39	25	31	28	44	606
Klipplaatdrift	0551853_W	25	34	25	12	29	1	561

The climate is characterised by hot and rainy summers for a long period as well as cool and dry winters over a short period.

2.1.2 Catchment Delineation

There were one catchment that was delineated.
The catchment areas are within the Olifants Water Management Area.

Catchments in the table below was delineated to cover the stream nearest to the project boundary and was utilised to determine the flood peaks for 1:100 return extreme events. The catchment information is listed in the table below.

Table 3 Catchment area

Catchment Site	Catchment area (km^2)	Remark	Quaternary catchment
C1	12.717	Catchment	B32G

Figure 5 Quaternary catchments

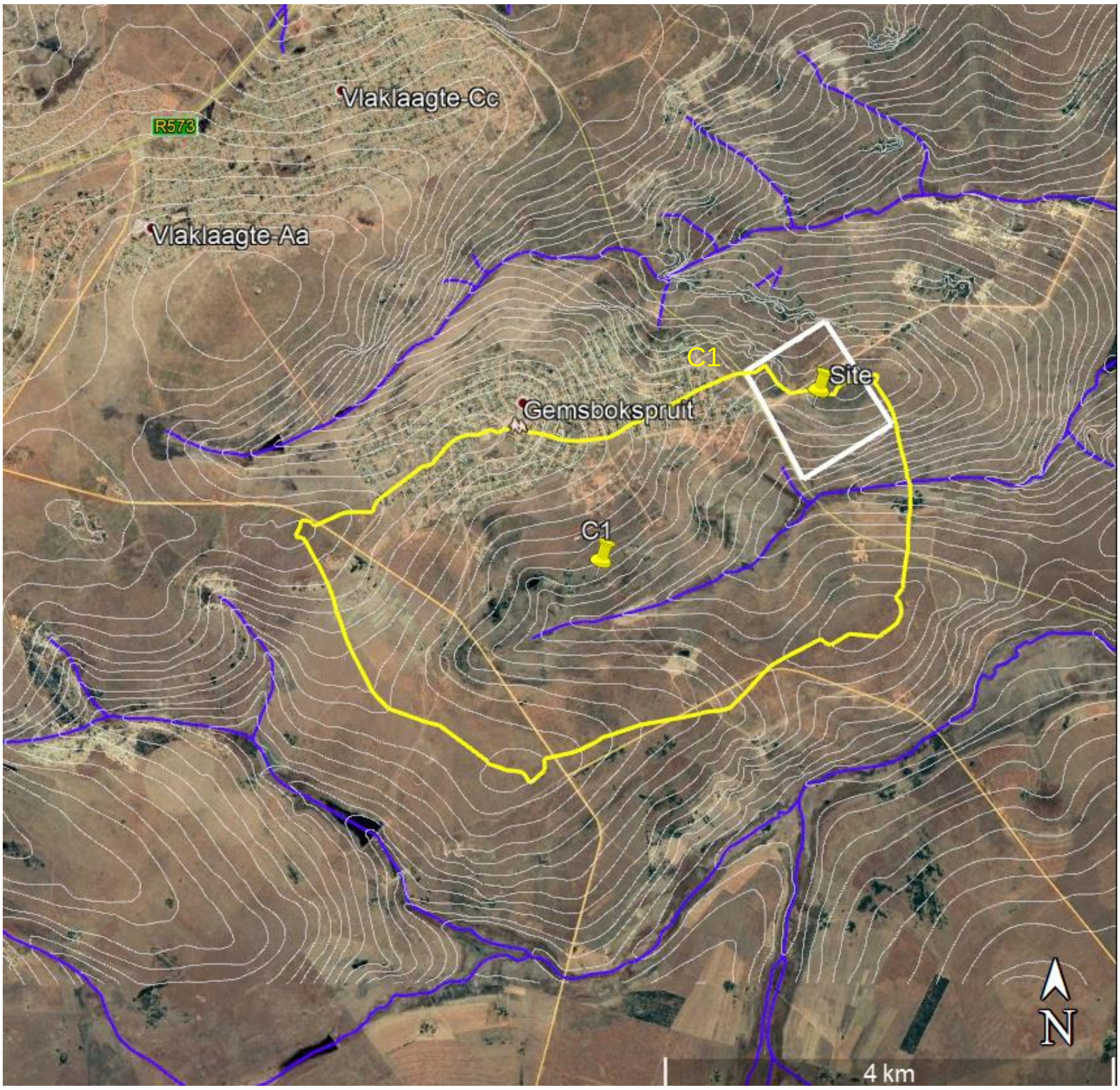

Figure 6 Catchment delineation (yellow line boundary)

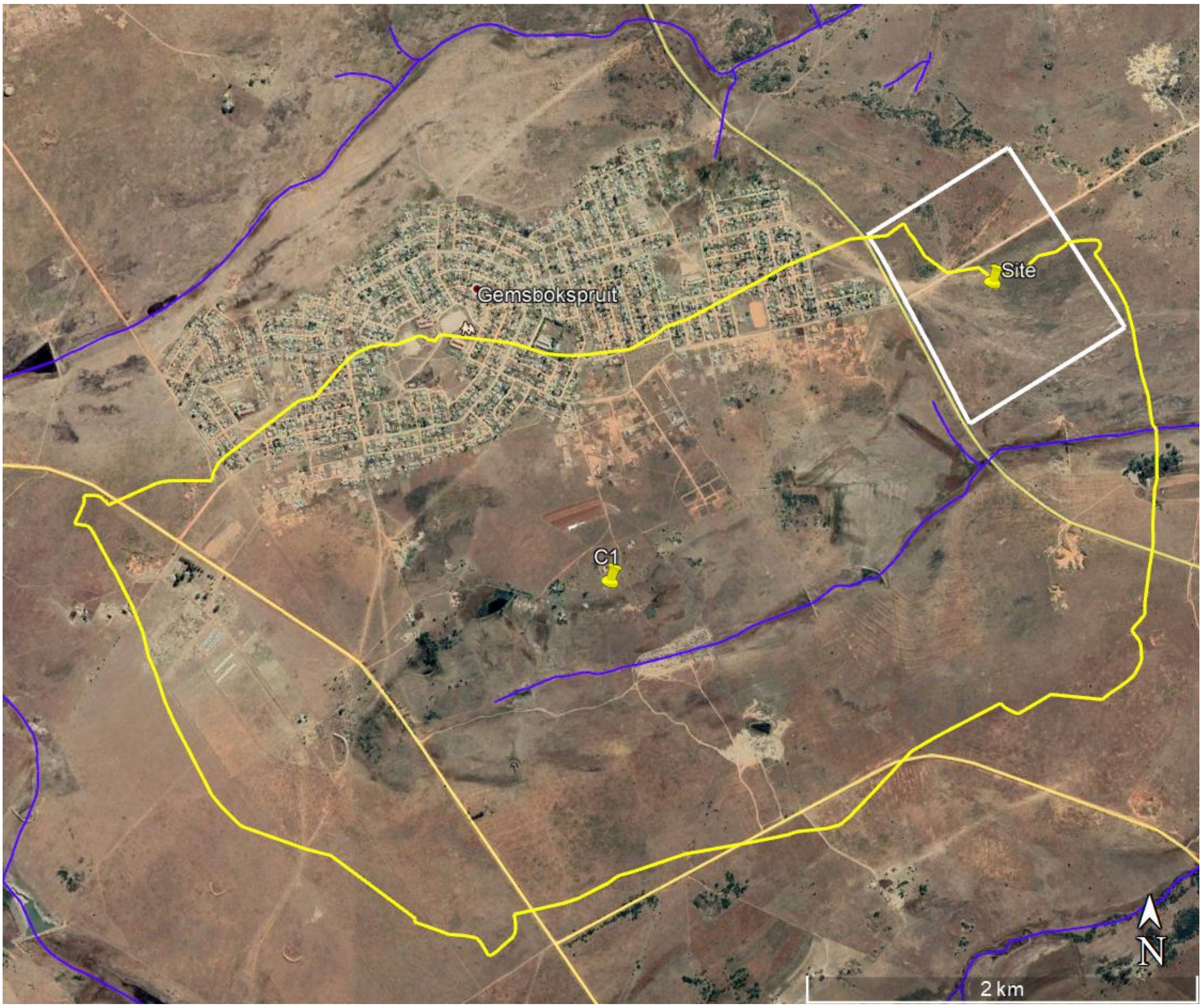

Figure 7 Catchment (yellow line boundary)

Table 4 Catchment Characteristic

Characteristic	**Rural**	**Urban**	**Lakes**	**Total**
	Distribution	**Distribution**	**Distribution**	
Catchment	**%**	**%**	**%**	**(%)**
C1	100%	0%	0%	100%

Table 5 Rural area - Surface slope

Rural area - Surface slope	**Lakes and pans (<3%)**	**Flat area (3 to 10%)**	**Hilly (10 to 30%)**	**Steep areas (>30%)**	**Total**
	Distribution	**Distribution**	**Distribution**	**Distribution**	
Catchment	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
C1	31%	69%	0%	0%	100%

Table 6 Rural area – Permeability

Rural area - Permeability	**Very permeable**	**Permeable**	**Semi-permeable**	**Impermeable**	**Total**
	Distribution	**Distribution**	**Distribution**	**Distribution**	
Catchment	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
C1	3%	24%	70%	3%	100%

Table 7 Rural area - Vegetation

Rural area - Vegetation	**Thick bush & forests**	**Light bush & cultivated land**	**Grasslands**	**Bare**	**Total**
	Distribution	**Distribution**	**Distribution**	**Distribution**	
Catchment					**(%)**
C1	1%	35%	50%	14%	100.0%

Table 8 Run-off factors

Catchment	**Run-off factor**			
	Rural (C_R)	**Urban (C_U)**	**Lakes (C_L)**	**Combined (C)**
C1	0.388	0	0	**0.388**

Table 9 Hydrological input data

Catchment	Catchment Area (km^2)	Longest water course (km)	Height difference 1085 method (m)	Days thunder was heard (No.)	Area Dolomite (%)	Mean Annual Precipitation (mm)	SDF Basin no. (No.)
C1	12.717	6.603	80.8	50	0	668	4

Table 10 Catchment characteristics

Catchment Site	Catchment area (km^2)	Longest water course, L (km)	Height difference along 10-85 slope (m)	Average slope S_{av} (m/m)	Time of concentration, Tc (hours)	% Slope	MAP (mm)	Run-off factor C
C1	12.717	6.603	80.8	0.01631659	1.38376528	1.63%	668	0.388

Flood magnitudes

The flood magnitudes from the 1:2 return up to 1:100 return floods are presented in the Tables below.

Table 11 Estimated stormwater flow (m^3/s)

	Rational method						**Alternative rational method**					
Return	**1:2**	**1:5**	**1:10**	**1:20**	**1:50**	**1:100**	**1:2**	**1:5**	**1:10**	**1:20**	**1:50**	**1:100**
Catchment												
C1	25.47	36.85	49.37	64.26	87.58	112.70	21.01	37.81	52.55	68.75	90.85	110.20

Table 12 Estimated stormwater flow (m^3/s)

	Standard design flood method					
Return	1:2	1:5	1:10	1:20	1:50	1:100
Catchment						
C1	6.32	26.05	44.62	65.79	97.56	124.37

The applications and limitation of flood calculation methods are shown in the table below.

Table 13 Applications and limitation of flood calculation methods

Method	Recommended maximum area (km^2)	Return period of floods that could be determined
Statistical method	No limitation (larger areas)	1:2 to 1:200
Rational method	Usually less than 15km^2	1:2 to 1:200
Unit Hydrograph method	15km^2 to 5,000km^2	1:2 to 1:100
Standard Design Flood method	No limitation	1:2 to 1:200
SCS-SA method	Less than 30km^2	1:2 to 1:100
Empirical methods	No limitation (larger areas)	1:10 to 1:100

Flood magnitudes for the 1:100-year floods

The Rational, Alternative Rational (AR), and Standard Design Flood (SDF) methods were used to select the flood peak.

The flow results were similar, therefore, the method with the highest magnitude of the peak flow was used for the 1:100 return flood for a sub-catchment.

The selected maximum peak flow is shown in the table below.

Table 14 Catchment generated estimated 1:100 peak flow

C1	Catchment, estimated 100year peak flow =	124.37	m^3/s

The estimated 1:100 stream flow is listed in the table below.

Table 15 Stream Peak flows estimates

Stream - Reach	Flow (m^3/s)
Stream 1	124.37

2.2 Flood line Modelling

The HEC-RAS model was used to determine the flood line during the event of a flood for any return period, and in this case the 1:100-year floods were modelled.

2.2.1 Cross section profile

Cross sectional data was generated using GIS and CAD software, as well as the contour lines that were obtained from the 5m contour lines that were obtained from the National Geo-Spatial Information (NGI). Sections shown in Annexure 5 were used to approximate the geometry for the river.

2.2.2 Flood profiles

Annexure 4 shows the longitudinal profile for the 1:100 return peak flow.

3.0 CONCLUSION

The determination of the 1:100 return period floodlines was undertaken for the site of the proposed development. The results of this determination provide an indication as to the extent of the areas that will be inundated by the 1:100 return design flood.

It is recommended that a buffer zone of 20m should be provided between the 1:100 flood line and any proposed development.

The lateral extent of the 1:100 return flood line is shown in Annexure 2. These flood lines have also been provided as Gauss Conform WGS84 LO29 coordinated CAD dwg softcopy files.

4.0 REFERENCES

- Smithers J.C. and Schulze R.E. (2002): Drainage rainfall and flood estimation in South Africa, WRC project KS/1060.

- The South African National Roads Agency Limited (2013): Drainage manual, 6th Edition.

ANNEXURE 1: FLOODLINE CERTIFICATE

Reg. No: 2014 / 233383 / 07

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Polokwane, Limpopo

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FLOOD LINE CERTIFICATE

Dalimede Projects (PTY) LTD was appointed by Nkanivo Development Consultants to undertake floodline assessment relating to the proposed Gemsbokspruit township establishment situated portion 4, 5, 13, remainder of portion 12 of the Farm Gemsbokspruit 229 JR, Mpumalanga Province.

This will entail to delineate the 1:100 return flood line.

Site: *Portion 4, 5, 13, remainder of portion 12 of the Farm Gemsbokspruit 229 JR*

Township Name: *Gemsbokspruit*

Co-ordinates: *25°24'13.15"S 28°54'15.91"E*

Municipality: *Thembisile Hani Local Municipality, in Nkangala District Municipality*

In terms of section 114 of the National Water Act, Act 36 of 1998 the above-mentioned property is Not affected by flood water within the 1:100 period from the stream / river as indicated in the floodline report. Development must be done outside of the floodline.

It is recommended that a buffer zone of 20m should be provided between the 1:100 flood line and any proposed development.

Thus, done and signed in ………………….…………. on this day……………..…………………..

Signature: …………………….................

Engineer: Litmos Mthunzi

Pr Tech Eng

Pr no.: …………………………

ANNEXURE 2: FLOODLINE DELINEATION

NOTES

KEY

FLOODLINE

CROSS SECTION

STREAM / RIVER

REVISIONS

REV	DATE	SIGN	DESCRIPTION
0	../../...	....	....

CLIENT

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DRAWING STATUS

FOR INFORMATION

PROJECT TITLE

Proposed Gemsbokspruit township establishment situated portion 4, 5, 13, remainder of portion 12 of the Farm Gemsbokspruit 229 JR, Mpumalanga Province

PROJECT LOCATION

The proposed township is situated in Gemsbokspruit, 90km north-east of Pretoria along the R573 Moloto road. GPS coordinates of site are 25°24'13.15"S 28°54'15.91"E.

DRAWING DESCRIPTION

FLOODLINE DELINEATION 1:100 RETURN PERIOD

SCALE	DATE	DESIGNED	DRAWN	CHECKED
As Shown	May 2021	LM	HM	CM

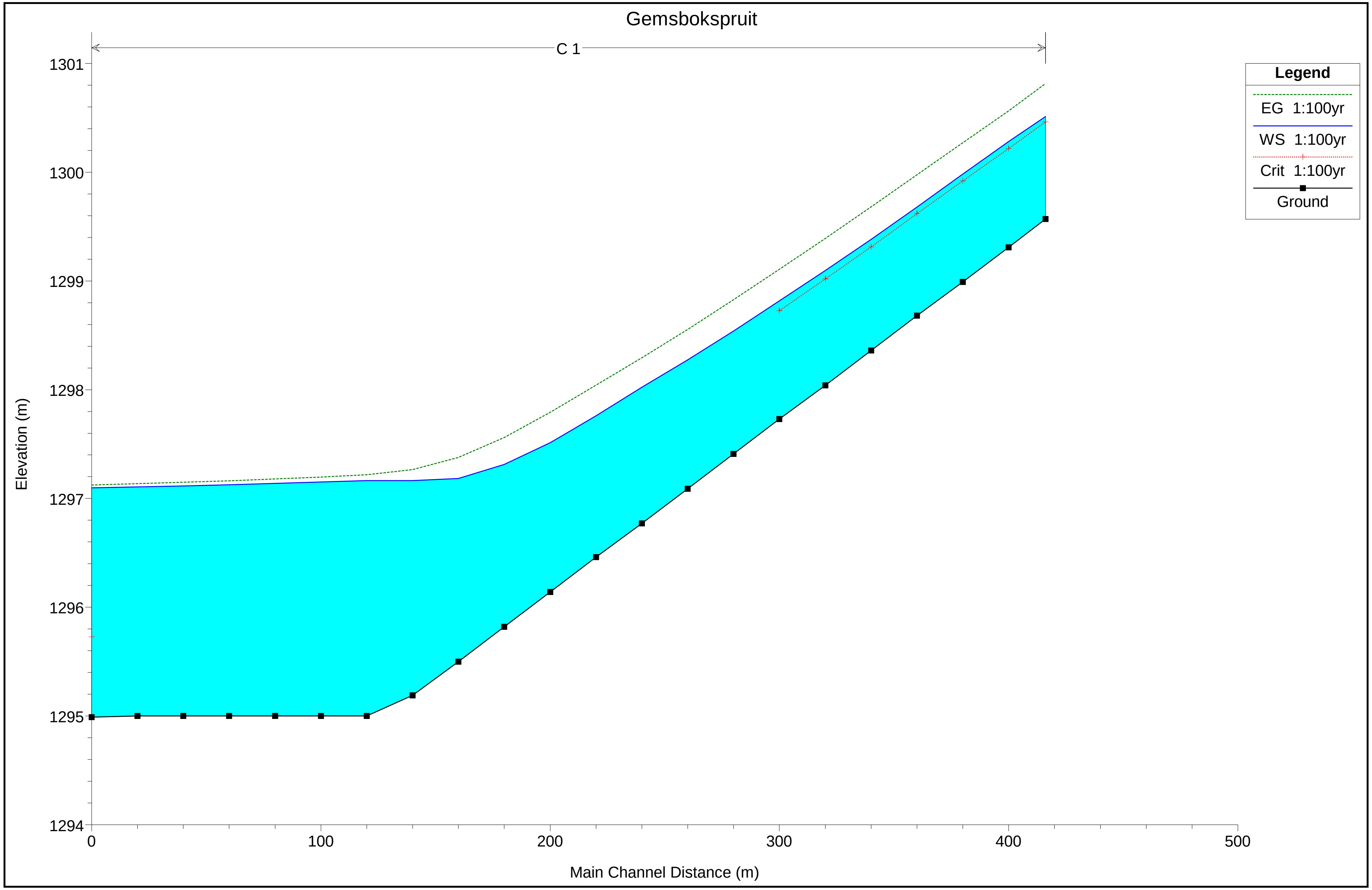
	DRAWING No.	REVISION
A1	GEMSBOKSPRUIT/FL/01	A

ANNEXURE 3: HEC-RAS PROGRAMME MODELLING RESULTS

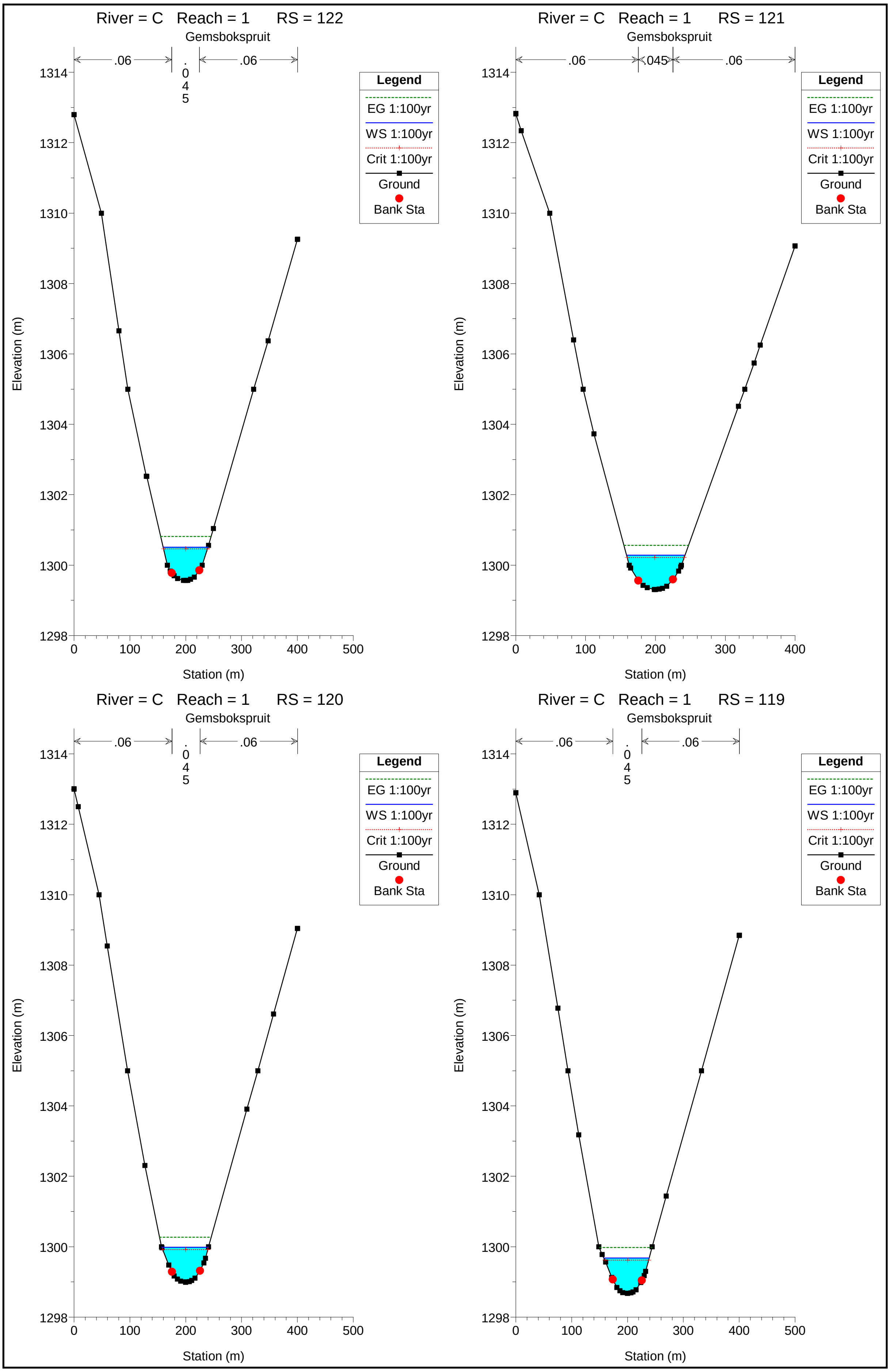
HEC-RAS Plan: Current mode River: C Reach: 1 Profile: 1:100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	122	1:100yr	124.37	1299.57	1300.51	1300.46	1300.82	0.016016	2.56	55.54	80.43	0.88
1	121	1:100yr	124.37	1299.31	1300.28	1300.22	1300.56	0.014476	2.47	57.99	83.38	0.84
1	120	1:100yr	124.37	1298.99	1299.98	1299.92	1300.27	0.014546	2.49	57.25	83.48	0.84
1	119	1:100yr	124.37	1298.68	1299.68	1299.62	1299.98	0.014769	2.50	55.77	81.23	0.85
1	118	1:100yr	124.37	1298.36	1299.38	1299.31	1299.68	0.014727	2.48	54.70	79.05	0.84
1	117	1:100yr	124.37	1298.04	1299.10	1299.02	1299.39	0.014249	2.44	54.47	77.17	0.83
1	116	1:100yr	124.37	1297.73	1298.82	1298.73	1299.11	0.014041	2.41	54.20	75.43	0.82
1	115	1:100yr	124.37	1297.41	1298.54		1298.83	0.013823	2.39	54.02	72.93	0.82
1	114	1:100yr	124.37	1297.09	1298.27		1298.55	0.013253	2.35	54.29	70.58	0.80
1	113	1:100yr	124.37	1296.77	1298.02		1298.29	0.012490	2.32	54.93	69.11	0.78
1	112	1:100yr	124.37	1296.46	1297.76		1298.04	0.012654	2.36	54.22	68.14	0.79
1	111	1:100yr	124.37	1296.14	1297.51		1297.79	0.012221	2.35	54.81	68.54	0.78
1	110	1:100yr	124.37	1295.82	1297.31		1297.56	0.010166	2.22	58.31	69.78	0.71
1	109	1:100yr	124.37	1295.50	1297.18		1297.38	0.007018	1.97	67.42	76.68	0.60
1	108	1:100yr	124.37	1295.19	1297.16		1297.27	0.002783	1.46	96.35	91.83	0.40
1	107	1:100yr	124.37	1295.00	1297.16		1297.22	0.001087	1.10	133.46	101.88	0.26
1	106	1:100yr	124.37	1295.00	1297.15		1297.20	0.000850	1.01	148.64	108.26	0.23
1	105	1:100yr	124.37	1295.00	1297.14		1297.18	0.000761	0.98	157.14	112.03	0.22
1	104	1:100yr	124.37	1295.00	1297.13		1297.16	0.000693	0.94	165.37	115.24	0.21
1	103	1:100yr	124.37	1295.00	1297.12		1297.15	0.000626	0.90	175.11	121.15	0.20
1	102	1:100yr	124.37	1295.00	1297.11		1297.14	0.000567	0.85	184.89	125.40	0.19
1	101	1:100yr	124.37	1294.99	1297.10	1295.73	1297.12	0.000501	0.81	196.52	129.56	0.18

ANNEXURE 4: LONGITUDINAL FLOW PROFILE FOR THE FLOOD PEAK


Gemsbokspruit
C 1
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Elevation (m)
1301
1300
1299
1298
1297
1296
1295
1294
0
100
200
300
400
500
Main Channel Distance (m)

ANNEXURE 5: FLOW CROSS SECTIONS FOR THE FLOOD PEAK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Gemsbokspruit
.06
.045
.06
Legend
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WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = C Reach = 1 RS = 121
Gemsbokspruit
.06
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.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = C Reach = 1 RS = 120
Gemsbokspruit
.06
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Legend
EG 1:100yr
WS 1:100yr
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Elevation (m)
Station (m)
River = C Reach = 1 RS = 119
Gemsbokspruit
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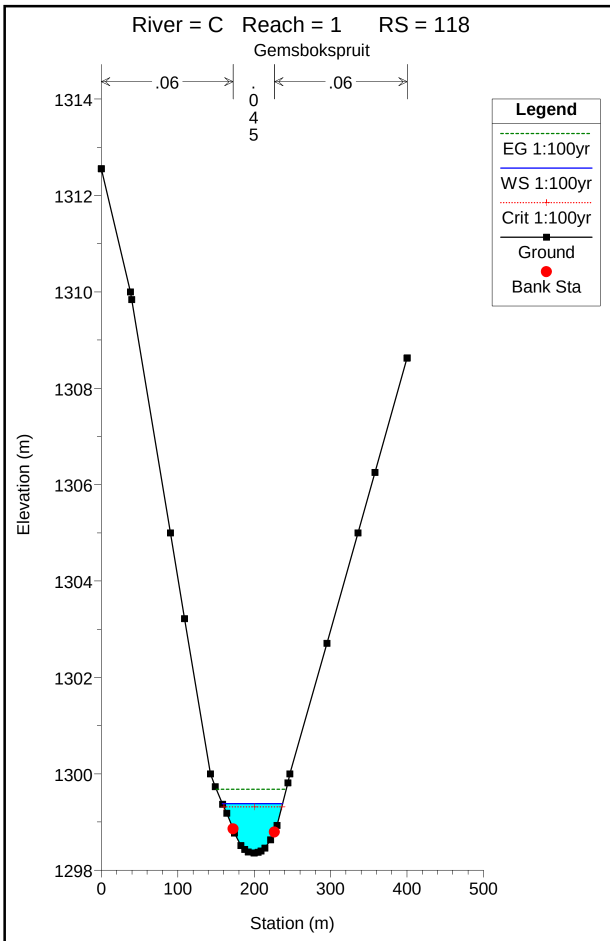
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)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Gemsbokspruit
.06
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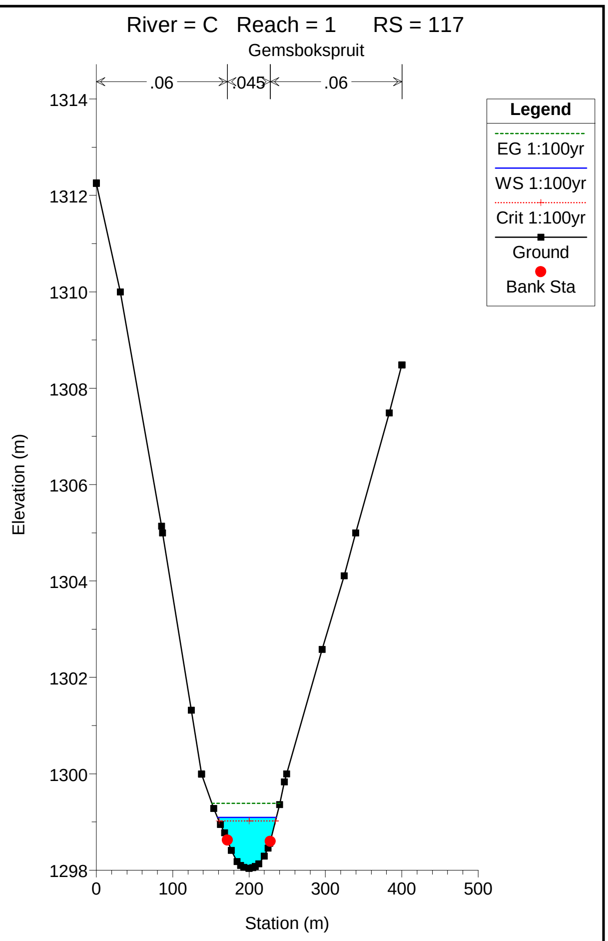
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1298
1300
1302
1304
1306
1308
1310
1312
1314
0
100
200
300
400
500
Station (m)


River = C Reach = 1 RS = 117
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1298
1300
1302
1304
1306
1308
1310
1312
1314
0
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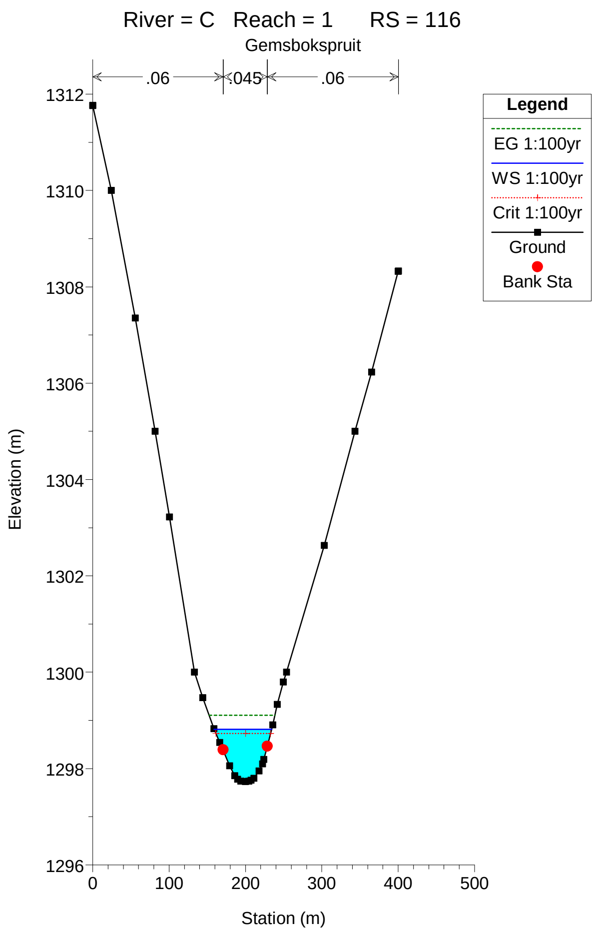
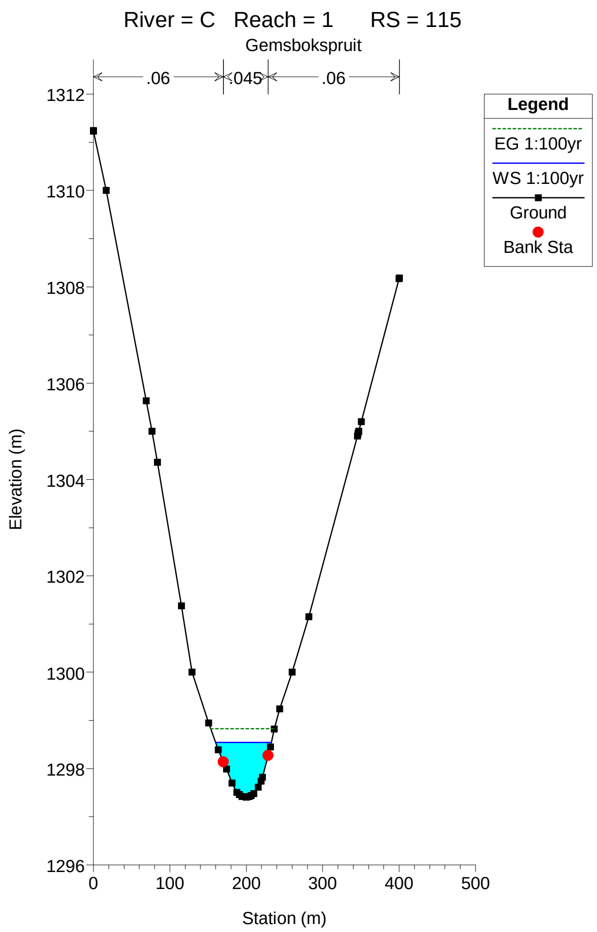
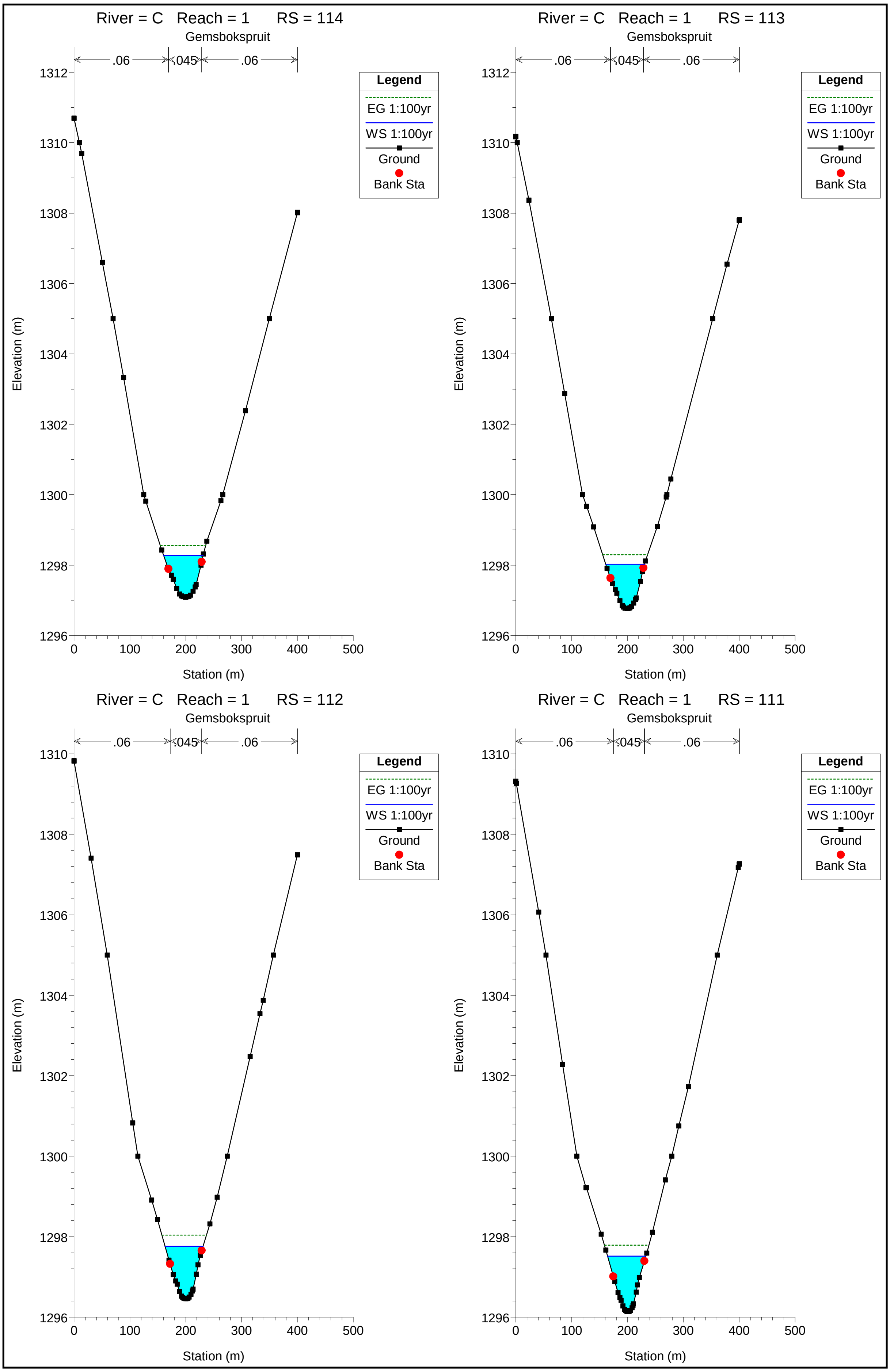
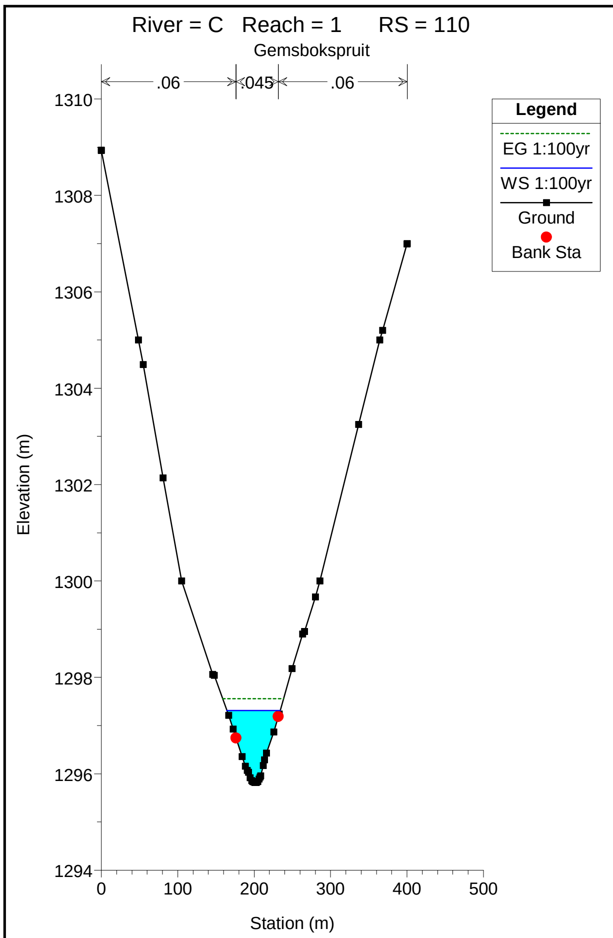
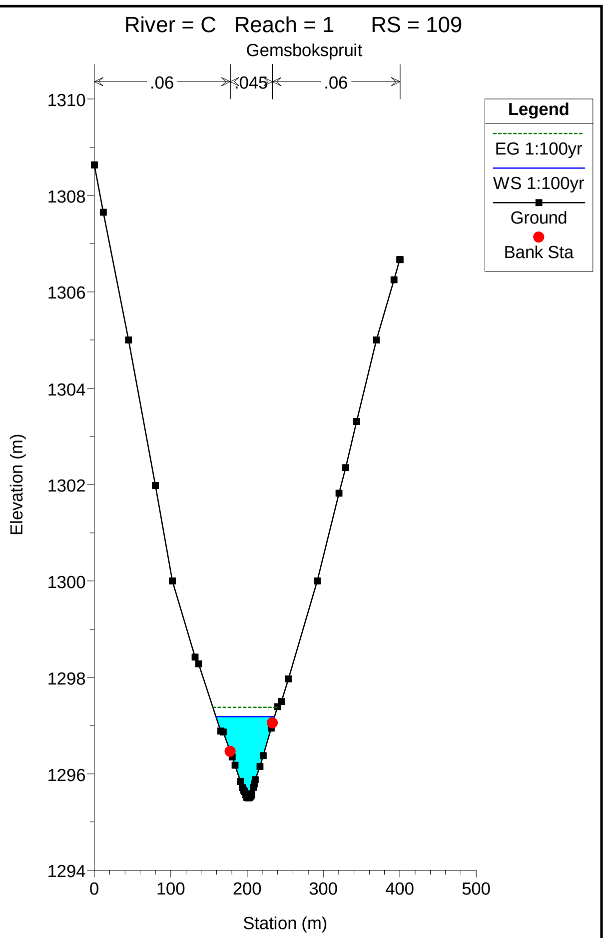
200
300
400
500
Station (m)

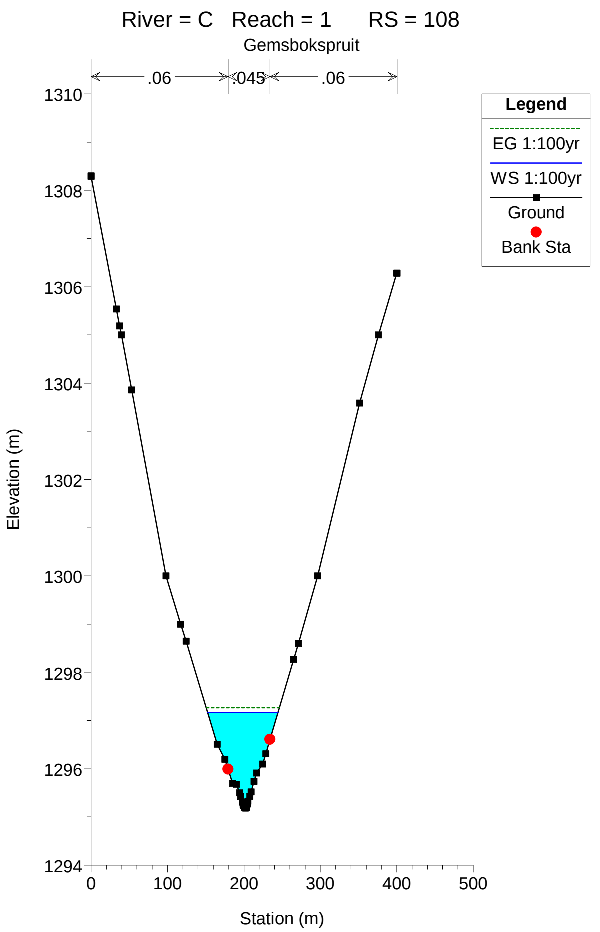

River = C Reach = 1 RS = 116
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1296
1298
1300
1302
1304
1306
1308
1310
1312
0
100
200
300
400
500
Station (m)

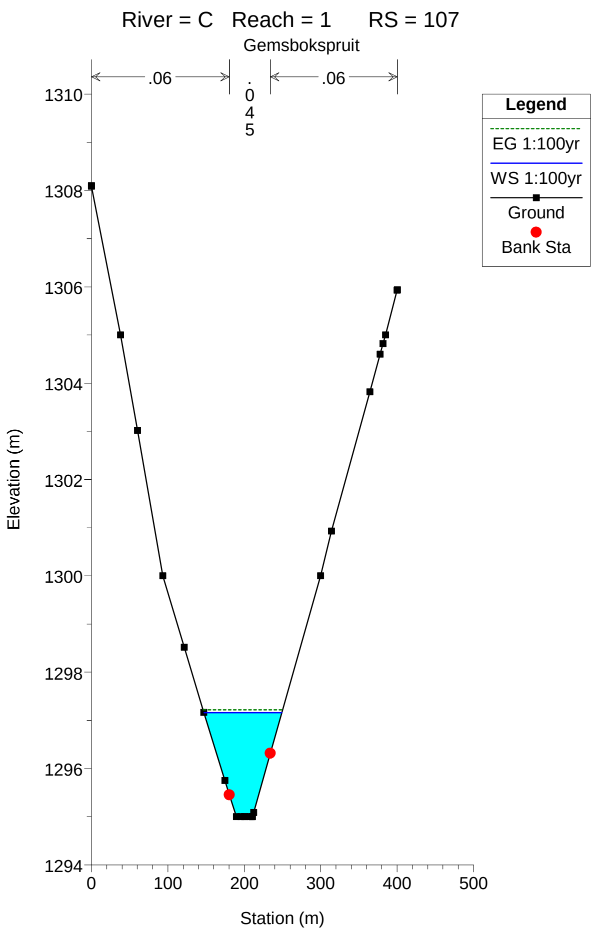

River = C Reach = 1 RS = 115
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1296
1298
1300
1302
1304
1306
1308
1310
1312
0
100
200
300
400
500
Station (m)

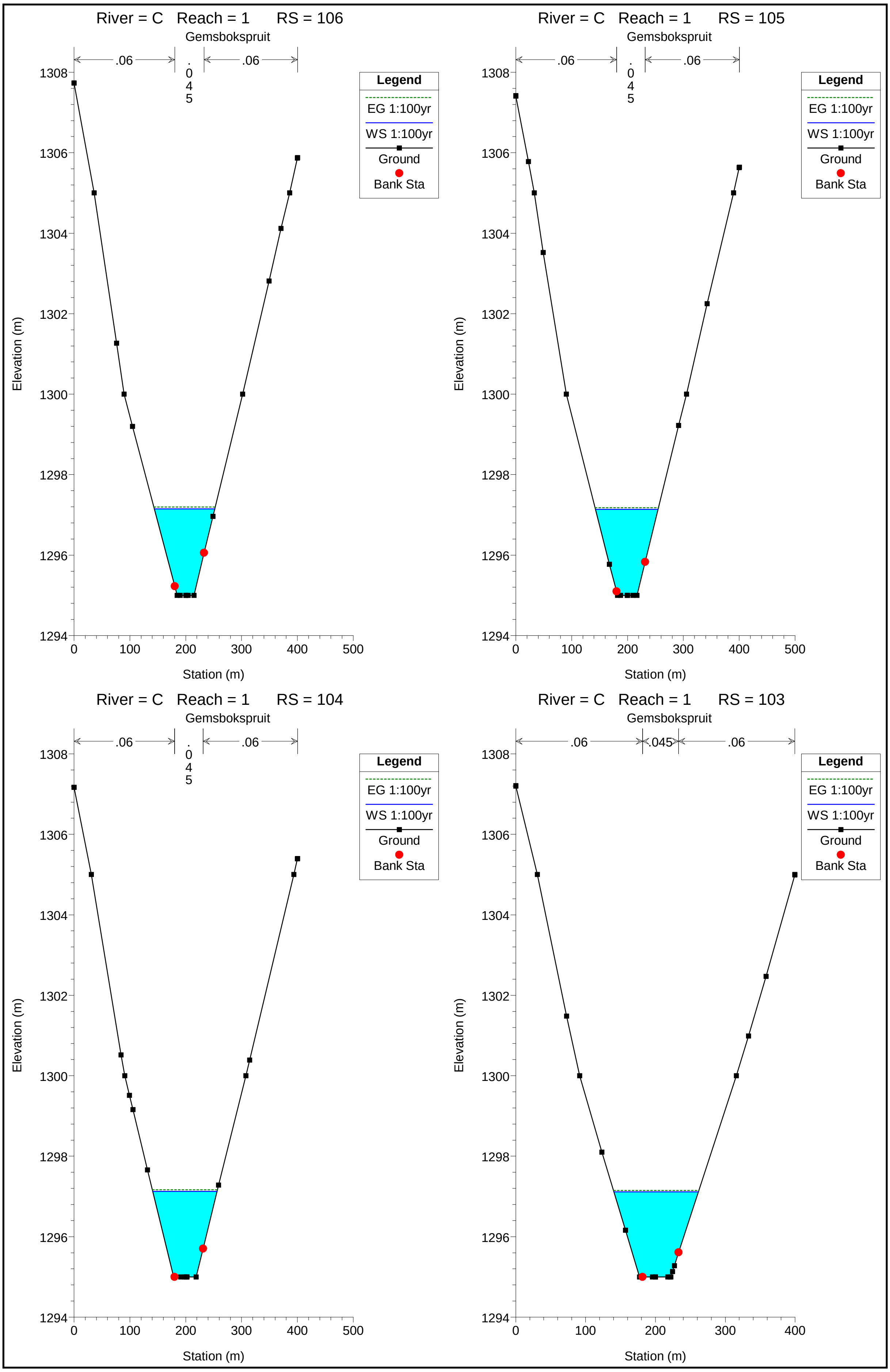

River = C Reach = 1 RS = 114
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1296
1298
1300
1302
1304
1306
1308
1310
1312
0
100
200
300
400
500
Station (m)
River = C Reach = 1 RS = 113
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1296
1298
1300
1302
1304
1306
1308
1310
1312
0
100
200
300
400
500
Station (m)
River = C Reach = 1 RS = 112
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1296
1298
1300
1302
1304
1306
1308
1310
0
100
200
300
400
500
Station (m)
River = C Reach = 1 RS = 111
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1296
1298
1300
1302
1304
1306
1308
1310
0
100
200
300
400
500
Station (m)

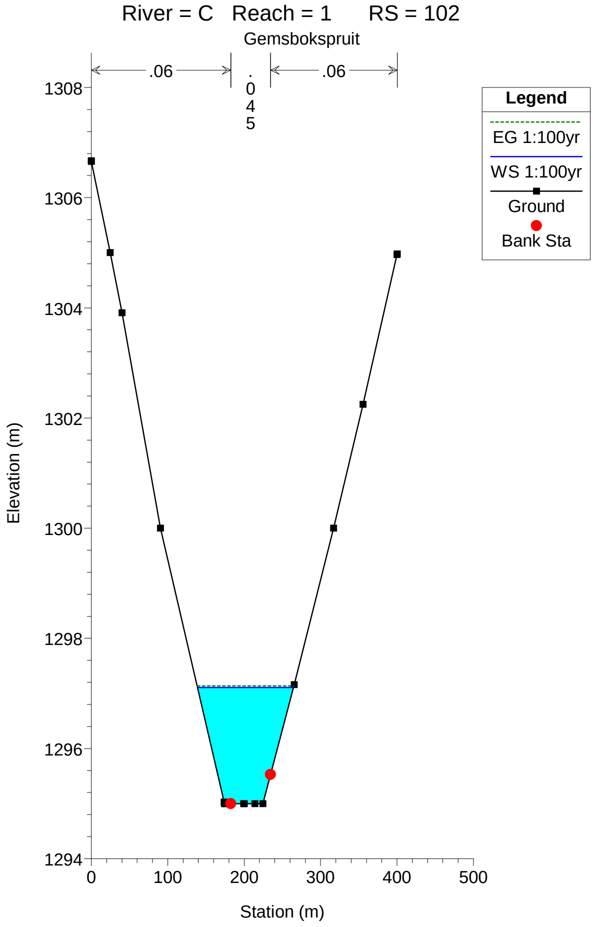

River = C Reach = 1 RS = 110
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1294
1296
1298
1300
1302
1304
1306
1308
1310
0
100
200
300
400
500
Station (m)

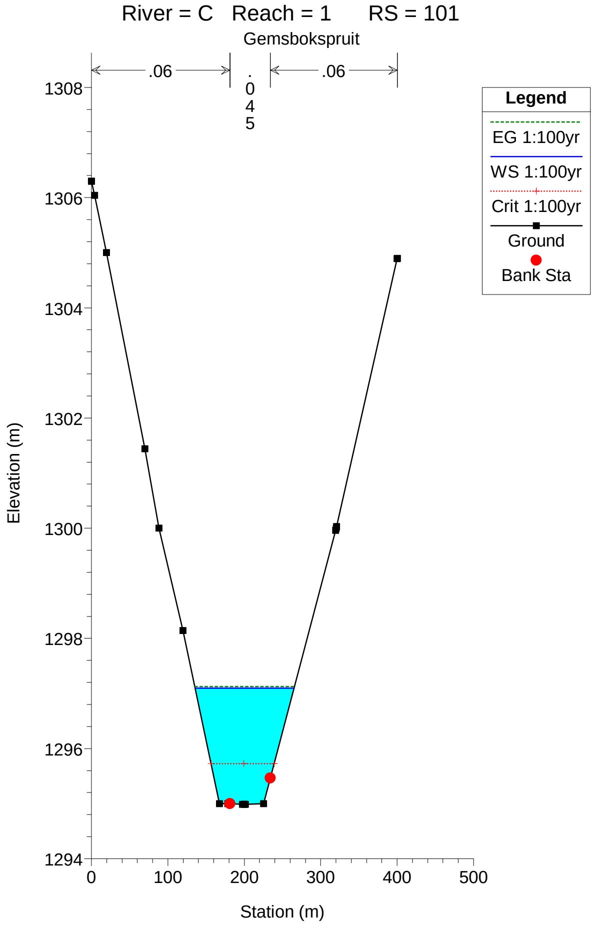

River = C Reach = 1 RS = 109
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1294
1296
1298
1300
1302
1304
1306
1308
1310
0
100
200
300
400
500
Station (m)


River = C Reach = 1 RS = 108
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1294
1296
1298
1300
1302
1304
1306
1308
1310
0
100
200
300
400
500
Station (m)


River = C Reach = 1 RS = 107
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1294
1296
1298
1300
1302
1304
1306
1308
1310
0
100
200
300
400
500
Station (m)


River = C Reach = 1 RS = 106
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1294
1296
1298
1300
1302
1304
1306
1308
Station (m)
0
100
200
300
400
500
River = C Reach = 1 RS = 105
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = C Reach = 1 RS = 104
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)
River = C Reach = 1 RS = 103
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
Station (m)


River = C   Reach = 1   RS = 102
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Ground
Bank Sta
Elevation (m)
1294
1296
1298
1300
1302
1304
1306
1308
0
100
200
300
400
500
Station (m)


River = C   Reach = 1   RS = 101
Gemsbokspruit
.06
.045
.06
Legend
EG 1:100yr
WS 1:100yr
Crit 1:100yr
Ground
Bank Sta
Elevation (m)
1294
1296
1298
1300
1302
1304
1306
1308
0
100
200
300
400
500
Station (m)