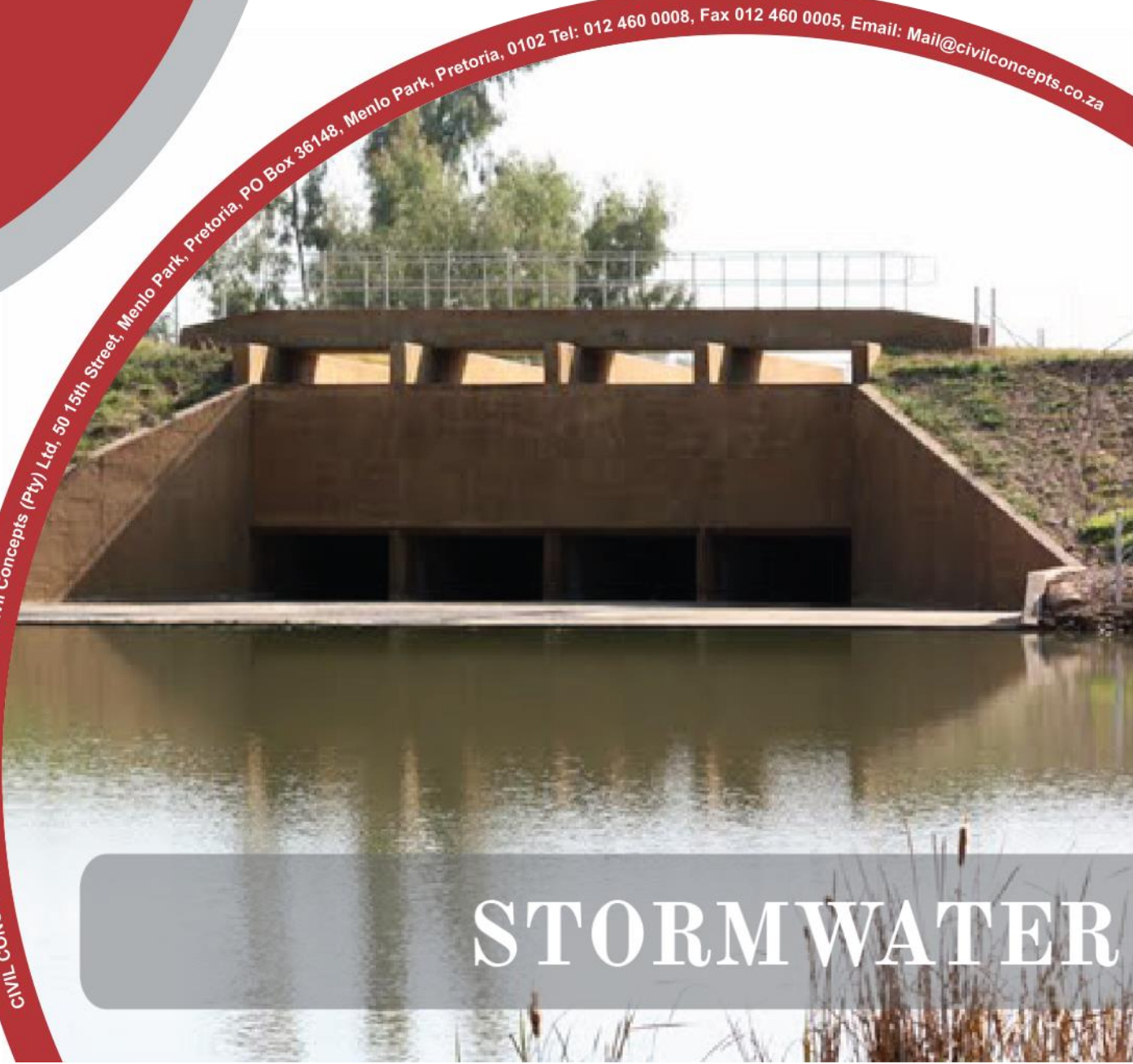




**KOSMOSDAL EXT 102
FLOODLINE REPORT**

**C3530/FL/001 REV 2
FEBRUARY 2026**



STORMWATER

CIVIL CONCEPTS CONSULTING ENGINEERS, Civil Concepts (Pty) Ltd, 50 15th Street, Menlo Park, Pretoria, 0102 Tel: 012 460 0008, Fax 012 460 0005, Email: Mail@civilconcepts.co.za

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Annexure A: Locality Plan

Annexure B: Catchment Layout

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Annexure E: HEC-RAS Results

Annexure F: Existing and Future Floodlines

Annexure G: Future Culvert Bridge

1 INTRODUCTION AND GENERAL INFORMATION

1.1 Introduction

Civil Concepts (Pty) Ltd was appointed by Samrand Development (Pty) Ltd to determine 1:50-year and 1:100-year floodlines affecting Kosmosdal X102.

The property is affected by the Rietspruit. Refer to **Annexure A** for the locality plan. A floodline report needs to be compiled and floodlines certified in order to comply with the National Water Act (Section 144 of act 36 of 1998) that states:

"For the purposes of ensuring that all persons who might be affected have access to information regarding potential flood hazards, no person may establish a township unless the layout plan shows, in a form acceptable to the local authority concerned, lines indicating the maximum level likely to be reached by flood waters on average once in every 100 years."

Furthermore, in terms of the City of Tshwane Municipality (CoT) Council Bylaws, no development may be flooded by a 1:50-year event.

The floodlines were determined based on the existing watercourse condition (2025) and future flow conditions. Allowance was also made in the analysis for a planned culvert bridge crossing of the spruit.

1.2 Location

Kosmosdal X102 are situated;

- North of Olievenhoutbosch 389-jr portion 249/R and 251/R
- East of Blue Hills X32
- South of Olievenhoutbosch 389-jr portions 70 and 72/R
- West of Olievenhoutbosch 389-jr portion 108

Refer to the locality Plan included in **Annexure A**.

1.3 Current Owner

Samrand Development (Pty) Ltd
Reg No 1994/000475/07
PO Box 40037
Cleveland
2022

Physical Address:
Block B, Eastgate Office Park
South Boulevard
Bruma
2198

Tel: 011 622 3026

Fax: 011 615 2296

Mail: cavgroup@cavaleros.co.za

1.4 Consulting Engineer

Name: Civil Concepts (Pty) Ltd
Postal: PO Box 36148, Menlopark, 0102
Tel: 012 460 0008
Fax: 012 460 0005
Mail: hannes@civilconcepts.co.za

The responsible person is: Mr JP Welman Pr Eng (ECSA Reg no 20180172)

1.5 Background information

Floodline delineation for the 1:50 and 1:100-year storm events were undertaken to determine, if any, what the impact the floodlines will have on the proposed township Kosmosdal X102. Thus, new flood analysis and report were completed.

2 DESCRIPTION OF THE WATERCOURSE

2.1 Rietspruit

The watercourse within the study area is a perennial watercourse with a low flow and can be classified as a minor stream with an irregular section. The Rietspruit's channel is moderately defined, with some parts having steep banks and other sections having a gentle slope. The spruit overbanks are irregular, with some low and high points. An existing dam is located along the watercourse within the study area. In addition, a historic dam showing a wall failure is also present, currently the watercourse is flowing through the breach in the dam wall.

Rietspruit is located on the eastern side of the proposed Kosmosdal X102 township, flowing in a northern direction, passing Rossway Quarry to the east of the Rietstruit and crossing under the N14.

Vegetation in and around the stream channel consists of open fields with mainly long, veld grass.

3 TOPOGRAPHIC DETAILS

Existing 2013 City of Tshwane LIDAR survey data on the NGL and N.J.Leonard Surveys 2015 survey were combined to create a working DEM and contours. This DEM was used in Hydrology and Hydraulic calculations. This formed the basis of the run-off and floodline calculations.

4 HYDROLOGY

Flood hydrology calculations were completed for the area to determine the 1:50-year and

1:100 year return period discharges for the sections of spruit under consideration. The catchment areas were delineated based on a 5m contour interval.

4.1 Catchment Characteristics

Catchment delineation and characteristics were determined using the DEM model, City of Tshwane cadastral information and Google Earth aerial imagery. A detailed layout of the delineation can be found in **Annexure B**.

Table 4.1.1 Summary of Catchment Characteristics

Catchment	Area (km ²)	Water course length (km)
C1	39.2	9.7
C2	32.7	9.5
C3	5.9	5.7

4.2 Hydrological Analysis

A selection of computation methods were used to analyse Catchment 1. Table 4.2.1 shows the possible application and limitations of each analysis method. In addition alternative methods were introduced based on recent research and previous projects of similar nature. Applicable methods were all used in analysis, based on limitations, and the best fitting result selected.

Table 4.2.1 Application of Hydrological Analysis methods

Method	Input Data	Recommended maximum area (km ²)	Return period of floods that could be determined (years)
Rational Method	Catchment area, water course length, average slope, catchment characteristics, rainfall intensity	<15	2 - 100
Alternative Rational Method 1	Catchment area, water course length, average slope, catchment characteristics, rainfall intensity	<15	2 - 100
Synthetic hydrograph method	Catchment area, water course length, length to catchment centroid, mean annual rainfall, veld type and synthetic regional unit graphs	15 - 5000	2 - 100
Standard Design Flood	Catchment Area, slope and SDF basin number	No limitation	2 – 200
Empirical methods	Catchment area, water course length, distance to catchment centroid, mean annual rainfall	No limitation	10 – 100, RMF
Adjusted Standard Design Flood	Catchment Area, slope and SDF basin number, Adjustment factor based on TR102 historical rainfall data	No limitation	2 – 200
IDF Curve Method	Catchment area, time of concentration, catchment characteristics, rainfall intensity	No limitation	2 - 100

Table 4.3.1 below shows a summary of the results obtained by analysis. After the hydrological analysis the results were compared and applied in the flood modelling, final run-off peaks used in modelling are included in the table.

The full computation results for Catchment A can be found in **Annexure C**.

4.3 Discussion of Results

As can be seen in Table 4.3.1 The IDF curve method was used to select the final run-off values for the catchment seeing that the Rational and Alternative 1 Rational Methods resulted in significantly high run-off values while the SDF and Empirical methods resulted in low results. As the IDF Curve method uses local intensity data this was considered the most appropriate method to use for the catchment. Zone C's IDF curve was used.

Catchment	Method	Flood Peaks (m ³ /s)		Final Flood Peaks (m ³ /s)	
		1:50	1:100	1:50	1:100
C1	Rational Method	352.5	426.8	290.9	331.9
	Alternative Rational Method	381.6	440.3		
	SDF	203.1	221.0		
	Unit Hydrograph	164.1	257.2		
	Empirical	206.4	242.8		
	IDF Curve Zone C	290.9	331.9		
Total					
C2	Rational Method	300.6	364.6	247.5	282.4
	Alternative Rational Method	325.7	375.8		
	SDF	173.35	219.5		
	Unit Hydrograph	139.16	188.2		
	Empirical	179.6	211.3		
	IDF Curve Zone C	247.5	282.4		
Total					
C3	Rational Method	86.4	106.2	70.4	80.3
	Alternative Rational Method	98.6	113.9		
	SDF	39.5	54.5		
	Unit Hydrograph	44.8	56.7		
	Empirical	39.9	50.4		
	IDF Curve Zone C	70.4	80.3		
Total					

Table 4.3.1 Final Flood Peaks for the Catchments

5 HYDRAULIC ANALYSIS

5.1 HEC-RAS Modelling

Analysis of the water course was modelled in HEC-RAS modelling software. The following scenario was modelled in HEC-RAS:

- Existing NGL and existing structures, and
- Existing NGL, structures and planned culvert bridge

The terrestrial survey data was entered into the HEC-RAS (Version 6.6.0) model. Roughness coefficients were applied based on a land cover map that was created by assigning roughness coefficients to areas of the DTM model. Only an average roughness is represented below.

All “natural cross sections” were abstracted from the Digital Elevation Model.

The HEC-RAS model main parameters are summarised in Table 5.1.1.

Table 5.1.1 HEC-RAS Model Main Parameters

Section	Parameters of the channel sections		
	Parameter	Average Value/Selection	Reason
Rietspruit	Average Roughness Coefficient (n)	Average for reach = 0.038	Light to medium dense bush, pools and existing bear areas
	Boundary conditions Upstream	Normal Depth S = 0.003 m/m	Upstream slope
	Boundary conditions Downstream	Normal Depth S = 0.035 m/m	Downstream slope
	Flow regime	Mixed flow	Slope and cross section changes requiring super and sub-critical flow regimes.

5.2 Existing Conditions and Structures

Currently there are 3 control points located along the Rietspruit within the study area. The control points are summarised in the Table 5.2.1 below.

Table 5.2.1 Control Points

Control Point	Chainage (m)	Type of Control
A	942	Broad Crested Weir
B	479	Broad Crested Weir
C	81	Broad Crested Weir

A broad crested weir is analysed using the equation listed below. Due to the width of the natural broad crested weir and subsequent lack of contraction of oncoming flow, 1.6 was used in place of 1.45 as the coefficient for the equation.

$$Q = 1.6 \times b \times H^{\frac{3}{2}}$$

b = flow width

H = Flow depth above Weir

Table 5.2.2 show the results of the hand check for each control point and compares them to the HEC-RAS model.

Table 5.2.2 Damming Level Comparison

Control Point	Damming level based on Hec-Ras (m above sea level)		Damming level based on the weir equation. (m above sea level)	
Storm Event	50-Year	100-Year	50-Year	100-Year
A	1458.62	1458.73	1460.39	1460.50
B	1455.90	1456.19	1456.81	1456.96
C	1452.12	1452.46	1453.63	1453.99

It can be seen in Table 5.2.2 The damming level determined by the weir equation is the critical value, which is due to the fact that the damming level is higher than the relevant HEC-RAS cross sections. The critical value was used when delineating the floodline.

5.3 Planned Culvert Bridge

A proposed new Culvert Bridge is planned underneath the future extension of Rietspruit Road. The culvert bridge will consist of 10 / 3000 x 2400mm precast box culvert units installed parallel to each other. The bridge will have the capacity to accommodate the 1:50-year and 1:100-year storm events with a level of 1459.70 and 1460.22 m, respectively. The damming behind the bridge will not affect the surrounding developments. A diagram of the proposed culvert bridge can be seen in Figure 5.3-1

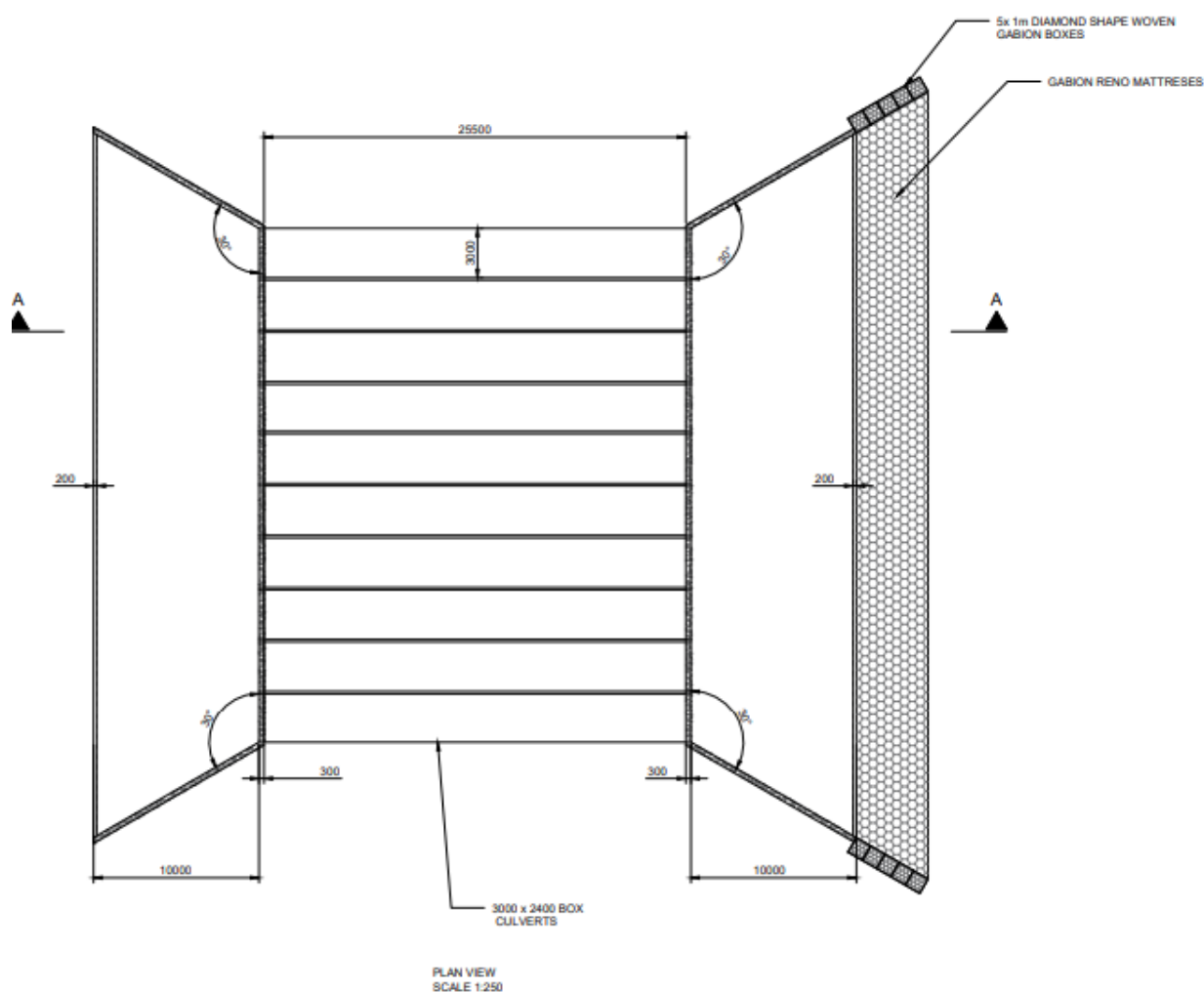


Figure 5.3-1 Planned Culvert Bridge

5.4 Rietspruit Hydraulics

The spruit has a varying slope and alignment, resulting in mixed flow conditions at some cross sections. Flows vary from sub-critical to super-critical. Froude numbers range between 0.2 to 2.55.

Figure 5.4-1 and Figure 5.4-2 have been extracted from the HEC-RAS model, showing the flow depth along the alignment, while Figure 5-4-3 has an extract from RAS Mapper of the flood model. All HEC-RAS cross-sections are included in **Annexure D** for reference.

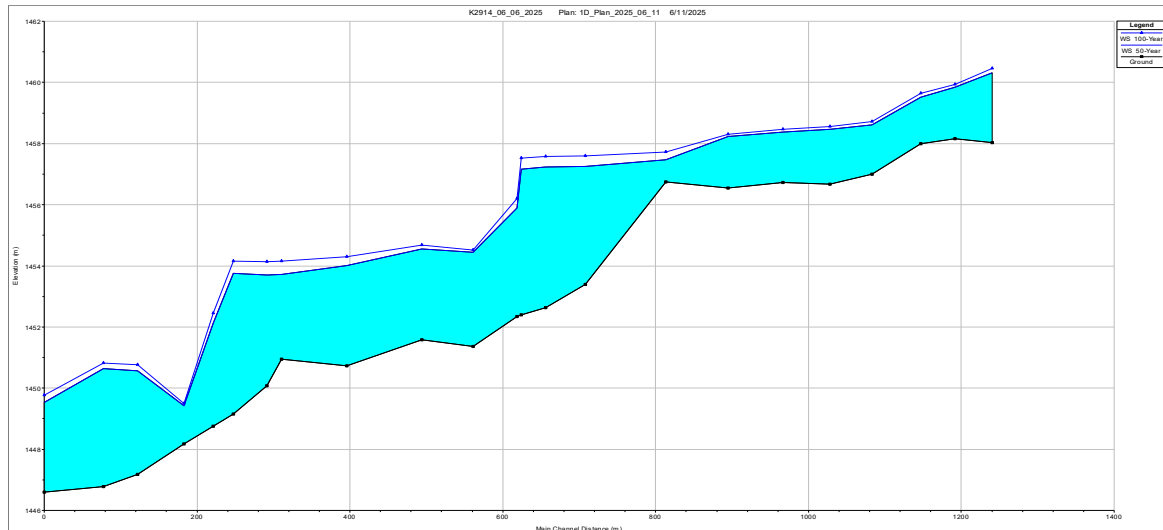


Figure 5.4-1 Existing Vertical Alignment of Rietspruit

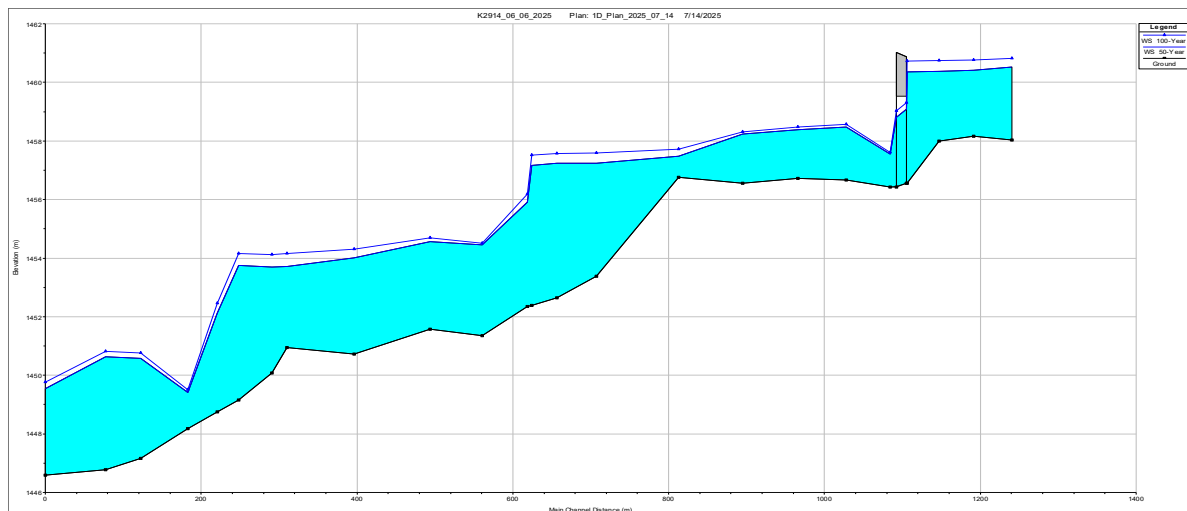


Figure 5.4-2 Future Vertical Alignment of Rietspruit

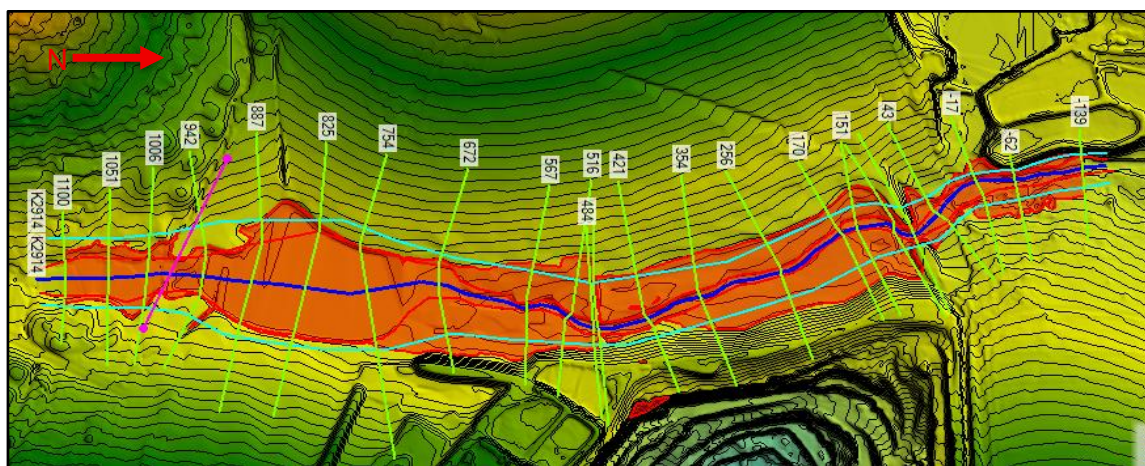


Figure 5.4-3 RAS Mapper extract

6 FLOODLINE DETERMINATION RESULTS

The 1:50 and 1:100 year floodlines were determined using peak flow rates as given in Table 4.3.1 for existing watercourse conditions together with HEC-RAS model outputs and hand corrections, sections were manually adjusted as per contour data between cross sections.

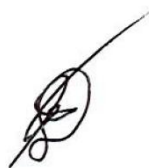
Separately from this, allowance was made for planned infrastructure to determine the possible effect on the existing floodlines.

Details of the HEC-RAS model output data are given in **Annexure E** and the existing floodlines are shown on Drawing C3456-FL-003 in **Annexure F**.

7 CONCLUSIONS

The following is concluded:

- The property is affected by the 1:50 and 1:100-year floodlines,
- The planned construction of the bridge needs to be done based on this report, and
- The existing floodlines are certified in terms of the Water Act.



LT Bowman
Candidate Engineer
February 2026



JP Welman
Pr Eng (20180172)
February 2026



FLOODLINE REPORT FOR KOSMOSDAL EXT 102

ANNEXURES

LIST OF ANNEXURES

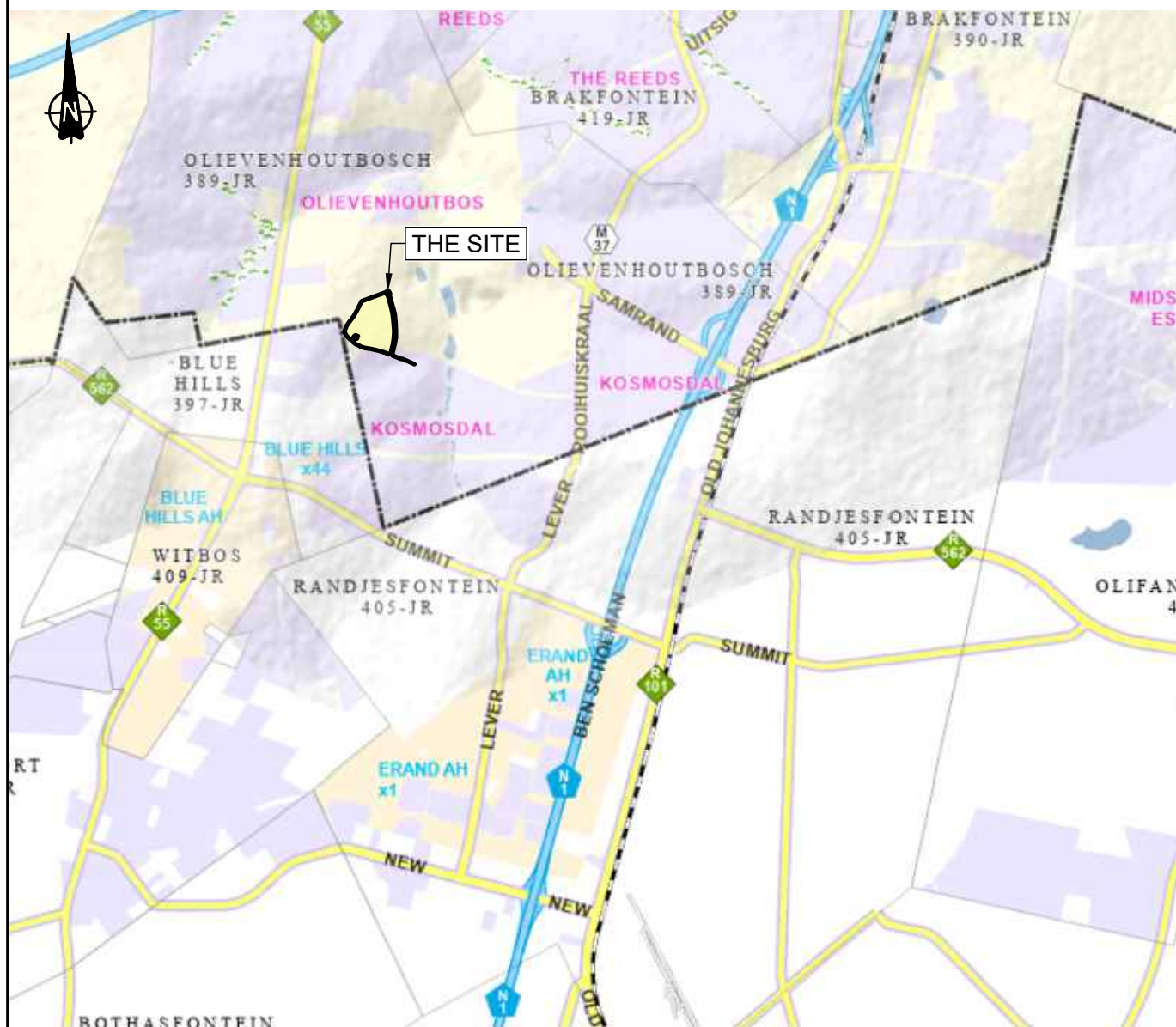
A	LOCALITY PLAN
B	CATCHMENT LAYOUT
C	HYDROLOGICAL CALCULATIONS
D	HEC-RAS CROSS SECTIONS
E	HEC-RAS RESULTS
F	EXISTING FLOODLINES LAYOUT
G	FUTURE CULVERT BRIDGE



**FLOODLINE REPORT FOR
KOSMOSDAL EXT 102**

ANNEXURES

ANNEXURE A
LOCALITY PLAN



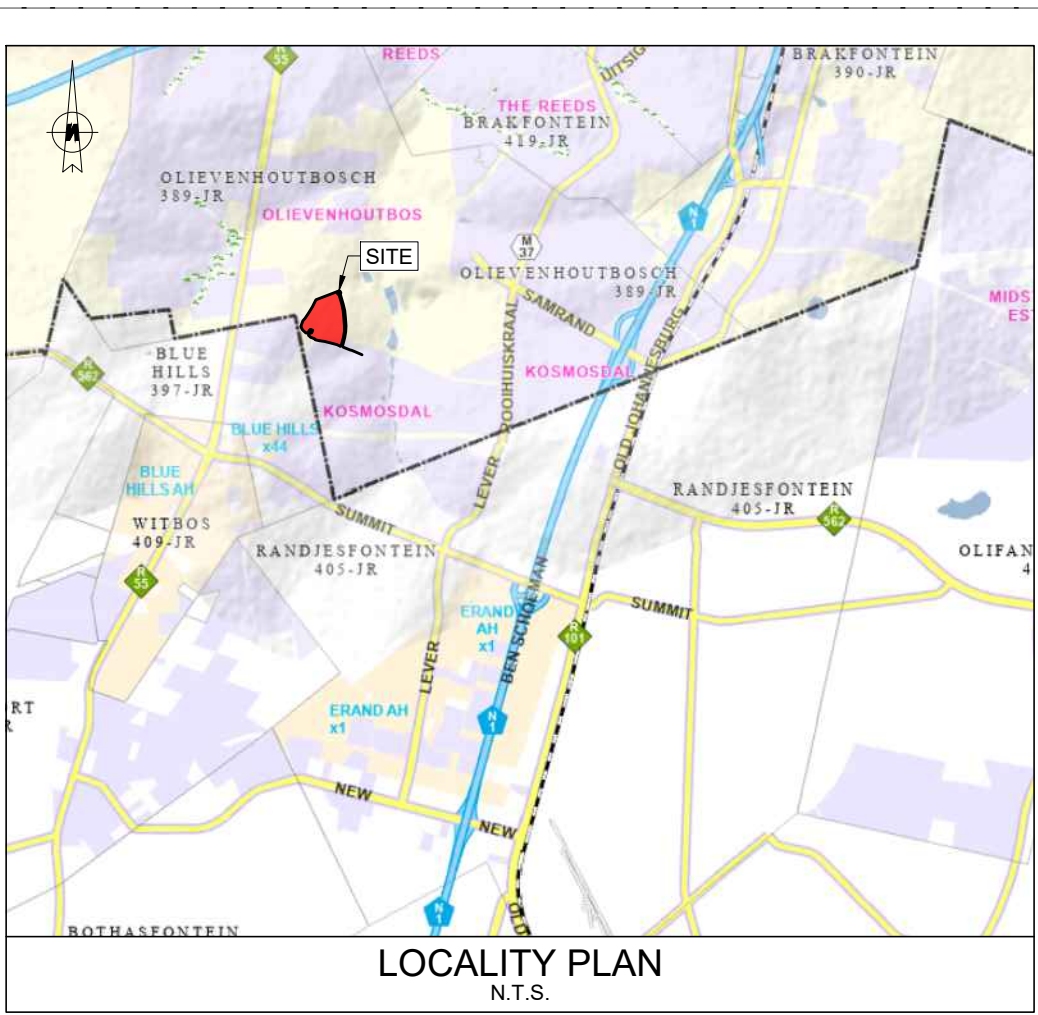
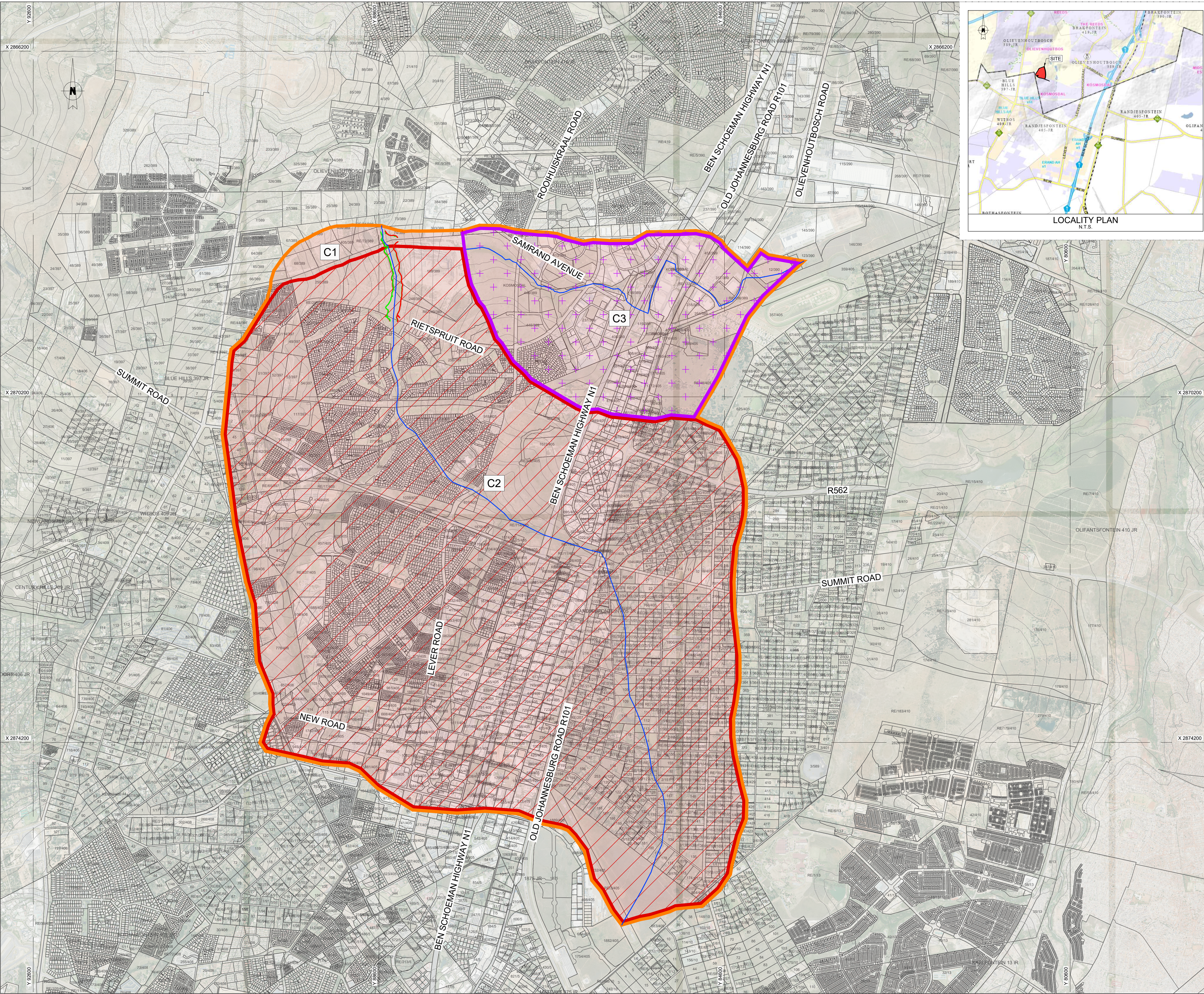
LOCALITY PLAN OF
KOSMOSDAL EXT.102
RIETSPRUIT



**FLOODLINE REPORT FOR
KOSMOSDAL EXT 102**

ANNEXURES

ANNEXURE B
CATCHMENT LAYOUT



NOTES AND SPECIFICATIONS

LEGEND:

- 1:50 YEAR FLOODLINE
- 1:100 YEAR FLOODLINE
- LONGEST WATERCOURSE
- CATCHMENT 1
- CATCHMENT 2
- CATCHMENT 3

	C1	C2	C3
AREA (km²)	39.2	32.7	5.9
LONGEST WATERCOURSE (km)	9.7	9.5	5.7
DOLOMITIC AREA (%)	0	0	0
AVERAGE SLOPE (m/m)	0.0186	0.0187	0.0211
TIME OF CONCENTRATION (h)	1.77	1.73	1.12
C-FACTOR	0.600	0.600	0.573
IDF ZONE	C	C	C
RETURN PERIOD	50	100	50
PEAK FLOW (m³/s)	290.9	331.9	80.3

FLOODWATER:

THIS IS TO CERTIFY THAT THE 1:50 & 1:100 YEAR FLOODLINE AS SHOWN ON DRAWING NO. C3530-FL-001 IS IN ACCORDANCE WITH THE SPECIFICATIONS AS LAID DOWN BY ARTICLE 169A OF THE WATER ACT (ACT 54 OF 1956) AS AMENDED BY ARTICLE 18 OF THE WATER AMENDMENT ACT (ACT 73 OF 1978) AND ARTICLE 144 AND 145 OF THE NATIONAL WATER ACT (ACT 36 OF 1998)

PROFESSIONAL ENGINEER :	J.P. WELMAN
REGISTRATION NO. :	20180172
SIGNATURE	DATE

DATE	NO	REVISION
20-02-2026	C	MINOR AMENDMENTS
03-07-2025	B	UPDATED CATCHMENT HATCH AND C2 AREA IN TABLE
29-04-2025	A	ISSUED FOR APPROVAL

CLIENT

CONSULTANT

Civil Concepts (Pty) Ltd
Consulting Civil & Structural Engineers
PO Box 36145, Menlo Park, 0102
Office: +27 12 460 0008
www.civilconcepts.co.za

PROJECT STATUS		
CONCEPT DRAWING	TENDER DRAWING	CONSTRUCTION DRAWING
PROJECT ENGINEER (CONSULTANT)		
J.P. WELMAN	20180172	20-02-2026
INSPECTOR OF WORKS (MUNICIPAL):		
INITIALS AND SURNAME		
"AS BUILT DRAWING"		
CC CONSULTING ENGINEER		
INITIALS AND SURNAME		
PROJECT		
KOSMOSDAL EXT. 102		
DRAWING TITLE		
FLOODLINE LAYOUT (CATCHMENT AREAS)		
PROJECT NO		REV. NO.
C3530-FL-001		C
SCALE	DESIGNED	L. BOWMAN
1:20 000	DRAWN	R.J. SMIT
DATE	CHECKED	J.P. WELMAN
JUNE 2025		



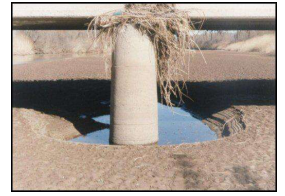
**FLOODLINE REPORT FOR
KOSMOSDAL EXT 102**

ANNEXURES

**ANNEXURE C
HYDROLOGICAL CALCULATIONS**

Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: C1
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\C1.fld
Date: 2 June 2025

Printed: 19 June 2025

Page 1

Summary of peak flows (m³/s)

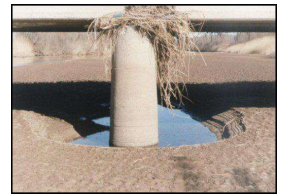
Method	1:2	1:5	1:10	1:20	1:50	1:100	1:200	Design year
Rational 1	132.95	179.56	225.38	275.59	352.52	426.76		20
Rational 2	111.14	187.76	245.96	304.32	381.56	440.29	498.46	20
Unit hydrograph	35.60	57.42	81.44	111.66	164.10	221.00		20
Standard design flood	16.35	57.40	95.52	138.68	203.08	257.17	314.58	20
Empirical			125.95	157.81	206.37	242.79		20
Statistical: LN								
Statistical: LEV1								
Statistical: LP3								
Statistical: EV1								
Class of road = Class 3 District Distributor								

Calculated using Utility Programs for Drainage 2.0.0

The software programs were developed for the convenience of its users. Although every reasonable effort has been made to ensure that the programs are accurate and reliable the program developers, Sinotech CC, accept no liability of any kind for any results, interpretation thereof or any use made of the results obtained with these programs. All users of these programs do so entirely at their own risk.
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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102

Analysed by: LT BOWMAN

Name of river: Rietspruit

Description of site: Kosmosdal X102

Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\K2914_2025_06_01

Date: 2 June 2025

Printed: 19 June 2025

Page 1

Summary of peak flows (m³/s)

Method	1:2	1:5	1:10	1:20	1:50	1:100	1:200	Design year
Rational 1	112.76	152.45	191.55	234.52	300.58	364.64		20
Rational 2	94.87	160.27	209.95	259.77	325.70	375.83	425.49	20
Unit hydrograph	30.43	49.31	70.04	94.84	139.16	188.23		20
Standard design flood	13.95	49.00	81.54	118.38	173.35	219.53	268.53	20
Empirical			109.62	137.36	179.63	211.32		20
Statistical: LN								
Statistical: LEV1								
Statistical: LP3								
Statistical: EV1								
Class of road = Class 3 District Distributor								

Calculated using Utility Programs for Drainage 2.0.0

The software programs were developed for the convenience of its users. Although every reasonable effort has been made to ensure that the programs are accurate and reliable the program developers, Sinotech CC, accept no liability of any kind for any results, interpretation thereof or any use made of the results obtained with these programs. All users of these programs do so entirely at their own risk.
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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Data Center
Analysed by: JP Welman
Name of river: Tributary of Rietspruit
Description of site: Kosmosdal 99&100
Filename: W:\CC-Projects\C PROJECTS\C3456 (LZ) KOSMOSDAL EXT 99 & 100 CDC CENTRAL (K2 962)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Catchment B.fld
Date: 29 May 2025

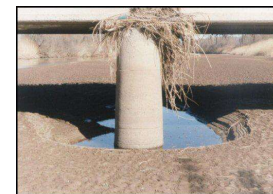
Printed: 29 May 2025

Page 1

Summary of peak flows (m³/s)

Method	1:2	1:5	1:10	1:20	1:50	1:100	1:200	Design year
Rational 1	31.26	42.58	53.89	66.53	86.39	106.21		10
Rational 2	28.69	48.49	63.54	78.65	98.64	113.86	128.90	10
Unit hydrograph	7.684	12.82	18.75	26.19	39.49	54.50		5
Standard design flood	3.605	12.66	21.07	30.58	44.79	56.72	69.38	5
Empirical			24.78	28.56	39.91	50.41		5
Statistical: LN								
Statistical: LEV1								
Statistical: LP3								
Statistical: EV1								
Class of road = Class 4 District Collector								

Utility Programs for Drainage Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: Kosmosdal X102
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\K2914_2025_06_
Date: 2 June 2025

Printed: 19 June 2025

Page 1

Flood Frequency Analysis: Rational Method 1

Project = Kosmosdal X102
 Analysed by = LT BOWMAN
 Name of river = Rietspruit
 Description of site = Kosmosdal X102
 Date = 6/2/2025
 Area of catchment = 39.2 km²
 Dolomitic area = 0.0 %
 Mean annual rainfall (MAR) = 683.00 mm
 Length of longest watercourse = 9.7 km
 Flow of water = Defined water course
 Height difference along 10-85 slope = 135.5 m
 Rainfall region = Inland
 Area distribution = Rural: 5 %, Urban: 95 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns	Residential and industry	Business
Sandy, flat (<2%) 2	Houses 50	City centre 0
Sandy, steep (>7%) 1	Flats 20	Suburban 0
Heavy soil, flat (<2%) 2	Light industry 12	Streets 10
Heavy soil, steep (>7%) 1	Heavy industry 2	Maximum flood 0

Catchment description - Rural area (%)

Surface slopes	Permeability	Vegetation
Lakes and pans 15	Very permeable 20	Thick bush & forests 5
Flat area 80	Permeable 70	Light bush & cultivated land 20
Hilly 4	Semi-permeable 5	Grasslands 74
Steep areas 1	Impermeable 5	Bare 1

 Average slope = 0.01863 m/m
 Time of concentration = 1.77 h
 Run-off factor
 Rural - C1 = 0.345
 Urban - C2 = 0.610
 Lakes - C3 = 0.000
 Combined - C = 0.597

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.77	37.4	97.4	20.6	0.75	59.2	132.95
1:5	1.77	51.0	96.5	27.8	0.80	59.3	179.56
1:10	1.77	64.5	95.5	34.8	0.85	59.4	225.38
1:20	1.77	79.6	94.5	42.5	0.90	59.5	275.59
1:50	1.77	103.5	92.8	54.3	0.95	59.6	352.52
1:100	1.77	127.4	91.2	65.7	1.00	59.7	426.76

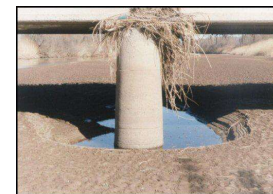
Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: Kosmosdal X102
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\K2914_2025_06_
Date: 2 June 2025

Printed: 19 June 2025

Page 2

Flood Frequency Analysis: Rational Method 2

Project = Kosmosdal X102
 Analysed by = LT BOWMAN
 Name of river = Rietspruit
 Description of site = Kosmosdal X102
 Date = 6/2/2025
 Area of catchment = 39.2 km²
 Dolomitic area = 0.0 %
 Length of longest watercourse = 9.7 km
 Flow of water = Defined water course
 Height difference along 10-85 slope = 135.5 m
 Area distribution = Rural: 5 %, Urban: 95 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns	Residential and industry	Business
Sandy, flat (<2%) 2	Houses 50	City centre 0
Sandy, steep (>7%) 1	Flats 20	Suburban 0
Heavy soil, flat (<2%) 2	Light industry 12	Streets 10
Heavy soil, steep (>7%) 1	Heavy industry 2	Maximum flood 0

Catchment description - Rural area (%)

Surface slopes	Permeability	Vegetation
Lakes and pans 15	Very permeable 20	Thick bush & forests 5
Flat area 80	Permeable 70	Light bush & cultivated land 20
Hilly 4	Semi-permeable 5	Grasslands 74
Steep areas 1	Impermeable 5	Bare 1

Days on which thunder was heard = 60 days/year

Weather Services station number = 513382

Weather Services station location = IRENE

Mean annual precipitation (MAP) = 660 mm

Duration 2 5 10 20 50 100 200

1 day 56 78 99 123 151 177 207

2 days 69 97 119 142 176 205 236

3 days 78 110 134 161 200 233 269

7 days 104 152 189 229 288 338 393

The modified recalibrated Hershfield relationship was used to determine point rainfall.

Average slope = 0.01863 m/m

Time of concentration = 1.77 h

Run-off factor

Rural - C1 = 0.345

Urban - C2 = 0.610

Lakes - C3 = 0.000

Combined - C = 0.597

Return period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.77	31.94	95.4	17.23	0.75	59.2	111.14
1:5	1.77	53.88	95.4	29.07	0.80	59.3	187.76
1:10	1.77	70.48	95.4	38.02	0.85	59.4	245.96
1:20	1.77	87.07	95.4	46.98	0.90	59.5	304.32
1:50	1.77	109.02	95.4	58.82	0.95	59.6	381.56
1:100	1.77	125.61	95.4	67.77	1.00	59.7	440.29
1:200	1.77	142.21	95.4	76.73	1.00	59.7	498.46

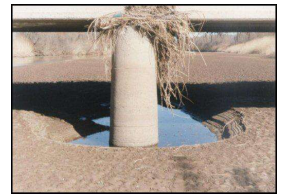
Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: C1
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\C1.fld
Date: 2 June 2025

Printed: 19 June 2025

Page 1

Flood Frequency Analysis: Empirical methods

Project = Kosmosdal X102
Analysed by = LT BOWMAN
Name of river = Rietspruit
Description of site = C1
Date = 02 Jun 2025

Area of catchment = 39.2 km²
Length of longest watercourse = 9.7 km
Height difference along equal-area slope = 132.5 m
Distance to catchment centroid = 4.003 km
Dolomitic area = 0.0 %
Mean annual rainfall = 683.0 mm
Veld type = 2 - All year
Kovács region = K5 (K = 5.0)
Catchment parameter with regard to reaction time = 0.118

Peak discharges by means of an empirical method developed by Midgley and Pitman

Return period (years)	KT constant	Peak flow (m ³ /s)
1:10	0.83	125.95
1:20	1.04	157.81
1:50	1.36	206.37
1:100	1.60	242.79

This RMF calculation includes a transition zone adjustment in the case of small catchments.

Regional maximum flood: 626.1 m³/s

Q50 (RMF): 257.49 m³/s (based on QT/QRMF relationship for Kovács regions)
Q100 (RMF): 323.48 m³/s (based on QT/QRMF relationship for Kovács regions)
Q200 (RMF): 395.90 m³/s (based on QT/QRMF relationship for Kovács regions)

The following equivalent maxima make no transition zone adjustments for small catchments.

Equivalent southern African maximum
K-factor 5.6: 1517 m³/s

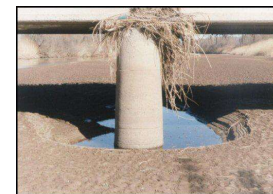
Equivalent world maxima
K-factor 6.0: 2737 m³/s
K-factor 6.3: 4261 m³/s

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: C1
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\C1.fld
Date: 2 June 2025

Printed: 19 June 2025

Page 1

Flood frequency analysis : Standard Design Flood method

Project name = Kosmosdal X102
 Analysed by = LT BOWMAN
 Name of river = Rietspruit
 Description of site = C1
 Date = 02 Jun 2025
 Catchment characteristics:
 Area of catchment = 39.2 km²
 Length of longest watercourse = 9.7 km
 1085 height difference = 135.5 m
 Average slope = 0.0186 m/m
 Drainage basin characteristics:
 Drainage basin number = 1
 Mean annual daily max rain = 56 mm
 Days on which thunder was heard = 30 days
 Runoff coefficient C2 = 10 %
 Runoff coefficient C100 = 40 %
 Basin mean annual precipitation = 550 mm
 Basin mean annual evaporation = 1800 mm
 Basin evaporation index MAE/MAP = 3.27

RAINFALL DATA

The rainfall data in the table below are derived from two sources. The daily rainfall is from the Department of Water Affairs' publication TR102 for the representative site. The modified Hershfield equation is used for durations up to four hours. Linear interpolation is used for values between 4 hours and one day.

Weather Services station ex TR102 = 546204 @ STRUAN
 Point mean annual precipitation = 550 mm

Dur:	RP =2	5	10	20	50	100	200
.25 h	15	25	33	41	51	59	67
.50 h	20	33	43	53	67	77	87
1 h	24	41	53	66	82	95	107
2 h	29	48	63	78	98	113	127
4 h	33	56	73	90	113	130	148
1 day	56	80	99	119	150	177	206
2 days	71	105	132	161	205	243	286
3 days	80	117	146	177	224	263	308
7 days	102	154	196	242	310	369	435

Runoff coefficients C2 = 10 % C100 = 40 %

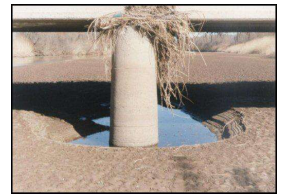
Return period (years)	Time of concentration (hours)	Point precipitation (mm)	ARF (%)	Catchment precipitation (mm)	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.77	27.8	95.4	26.5	10.0	16.35
1:5	1.77	46.9	95.4	44.7	20.8	57.40
1:10	1.77	61.4	95.4	58.5	26.5	95.52
1:20	1.77	75.8	95.4	72.3	31.1	138.68
1:50	1.77	94.9	95.4	90.5	36.4	203.08
1:100	1.77	109.4	95.4	104.3	40.0	257.17
1:200	1.77	123.8	95.4	118.1	43.2	314.58

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: C1
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\C1.fld
Date: 2 June 2025

Printed: 19 June 2025

Page 1

Flood Frequency Analysis: Unit Hydrograph Method

Project = Kosmosdal X102
 Analysed by = LT BOWMAN
 Name of river = Rietspruit
 Description of site = C1
 Date = 02 Jun 2025
 Area of catchment = 39.2 km²
 Length of longest watercourse = 9.7 km
 Height difference along equal area slope = 132.5 m
 Distance to catchment centroid = 4.003 km
 Veld type = Region 4
 Duration interval = 5 minutes

Slope of longest stream = 0.0137 m/m
 Catchment index = 332.2
 Catchment lag = 2.646
 Coefficient (Ku) = 0.386 m³/s - hours/km²
 Peak discharge of unit hydrograph (Qp) = 5.719 m³/s

Return period = 1:2 year

Storm duration (minutes)	Point rainfall (mm)	Point intensity (mm/h)	ARF (%)	Average rainfall (mm)	Runoff factor (%)	Effective rain (mm)
5	10.2	121.8	85.1	8.6	6.6	0.57
10	14.4	86.7	89.4	12.9	9.4	1.22
15	18.4	73.5	91.0	16.7	11.7	1.95
20	21.3	64.0	92.2	19.7	13.2	2.60
25	23.7	56.8	93.1	22.0	14.4	3.17
30	25.6	51.1	93.7	24.0	15.3	3.66
35	27.1	46.5	94.3	25.6	16.0	4.10
40	28.5	42.7	94.8	27.0	16.6	4.49
45	29.6	39.5	95.2	28.2	17.1	4.83
50	30.7	36.8	95.5	29.3	17.6	5.14
55	31.6	34.4	95.8	30.2	17.9	5.43
60	32.4	32.4	96.0	31.1	18.3	5.69
65	33.1	30.6	96.3	31.9	18.6	5.93
70	33.8	29.0	96.5	32.6	18.9	6.15
75	34.4	27.5	96.6	33.3	19.1	6.36
80	35.0	26.3	96.8	33.9	19.3	6.55
85	35.5	25.1	96.9	34.4	19.5	6.73
90	36.0	24.0	97.1	35.0	19.7	6.90
95	36.5	23.0	97.2	35.5	19.9	7.06
100	36.9	22.2	97.3	35.9	20.1	7.21
105	37.3	21.3	97.4	36.4	20.2	7.36
110	37.7	20.6	97.5	36.8	20.4	7.49
115	38.1	19.9	97.6	37.2	20.5	7.62
120	38.4	19.2	97.6	37.5	20.6	7.75
125	38.8	18.6	97.7	37.9	20.8	7.86
130	39.1	18.0	97.8	38.2	20.9	7.98
135	39.4	17.5	97.9	38.5	21.0	8.09
140	39.7	17.0	97.9	38.8	21.1	8.19
145	39.9	16.5	98.0	39.1	21.2	8.29
150	40.2	16.1	98.0	39.4	21.3	8.39
155	40.5	15.7	98.1	39.7	21.4	8.49
160	40.7	15.3	98.1	39.9	21.5	8.58
165	40.9	14.9	98.2	40.2	21.6	8.66
170	41.2	14.5	98.2	40.4	21.6	8.75
175	41.4	14.2	98.3	40.7	21.7	8.83
180	41.6	13.9	98.3	40.9	21.8	8.91
185	41.8	13.6	98.3	41.1	21.9	8.99
190	42.0	13.3	98.4	41.3	21.9	9.07
195	42.2	13.0	98.4	41.5	22.0	9.14
200	42.4	12.7	98.4	41.7	22.1	9.21
205	42.6	12.5	98.5	41.9	22.1	9.28

2635	0.048	32.208
2640	0.048	32.159
2645	0.048	32.111
2650	0.048	32.063
2655	0.047	32.015
2660	0.047	31.967
2665	0.047	31.919
2670	0.047	31.872
2675	0.047	31.824
2680	0.047	31.777
2685	0.047	31.730
2690	0.047	31.683
2695	0.047	31.636
2700	0.047	31.590
2705	0.047	31.543
2710	0.047	31.497
2715	0.046	31.451
2720	0.046	31.405
2725	0.046	31.359
2730	0.046	31.313
2735	0.046	31.268
2740	0.046	31.222
2745	0.046	31.177
2750	0.046	31.132
2755	0.046	31.087
2760	0.046	31.042
2765	0.046	30.997
2770	0.046	30.953
2775	0.045	30.908
2780	0.045	30.864
2785	0.045	30.820
2790	0.045	30.776
2795	0.045	30.732
2800	0.045	30.688
2805	0.045	30.645
2810	0.045	30.601
2815	0.045	30.558
2820	0.045	30.515
2825	0.045	30.472
2830	0.045	30.429
2835	0.044	30.386
2840	0.044	30.344
2845	0.044	30.301
2850	0.044	30.259
2855	0.044	30.217
2860	0.044	30.175
2865	0.044	30.133
2870	0.044	30.091
2875	0.044	30.049
2880	0.044	30.008

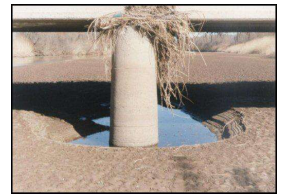
Return period	Storm duration (minutes)	Peak discharge (m ³ /s)
1:2 year	30	35.60
1:5 year	30	57.42
1:10 year	90	81.44
1:20 year	90	111.66
1:50 year	90	164.10
1:100 year	90	221.00

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: Kosmosdal X102
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\K2914_2025_06_
Date: 2 June 2025

Printed: 19 June 2025

Page 1

Flood Frequency Analysis: Rational Method 1

Project = Kosmosdal X102
 Analysed by = LT BOWMAN
 Name of river = Rietspruit
 Description of site = Kosmosdal X102
 Date = 6/2/2025
 Area of catchment = 32.66 km²
 Dolomitic area = 0.0 %
 Mean annual rainfall (MAR) = 683.00 mm
 Length of longest watercourse = 9.469 km
 Flow of water = Defined water course
 Height difference along 10-85 slope = 132.5 m
 Rainfall region = Inland
 Area distribution = Rural: 5 %, Urban: 95 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns	Residential and industry	Business
Sandy, flat (<2%) 2	Houses 50	City centre 0
Sandy, steep (>7%) 1	Flats 20	Suburban 0
Heavy soil, flat (<2%) 2	Light industry 12	Streets 10
Heavy soil, steep (>7%) 1	Heavy industry 2	Maximum flood 0

Catchment description - Rural area (%)

Surface slopes	Permeability	Vegetation
Lakes and pans 15	Very permeable 20	Thick bush & forests 5
Flat area 80	Permeable 70	Light bush & cultivated land 20
Hilly 4	Semi-permeable 5	Grasslands 74
Steep areas 1	Impermeable 5	Bare 1

 Average slope = 0.01866 m/m
 Time of concentration = 1.73 h
 Run-off factor
 Rural - C1 = 0.345
 Urban - C2 = 0.610
 Lakes - C3 = 0.000
 Combined - C = 0.597

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.73	37.3	97.7	21.0	0.75	59.2	112.76
1:5	1.73	50.7	96.9	28.3	0.80	59.3	152.45
1:10	1.73	64.2	96.0	35.5	0.85	59.4	191.55
1:20	1.73	79.3	95.1	43.5	0.90	59.5	234.52
1:50	1.73	103.1	93.6	55.6	0.95	59.6	300.58
1:100	1.73	126.8	92.1	67.4	1.00	59.7	364.64

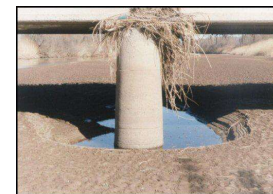
Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

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Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: Kosmosdal X102
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\K2914_2025_06_
Date: 2 June 2025

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Flood Frequency Analysis: Rational Method 2

Project = Kosmosdal X102
Analysed by = LT BOWMAN
Name of river = Rietspruit
Description of site = Kosmosdal X102
Date = 6/2/2025
Area of catchment = 32.66 km²
Dolomitic area = 0.0 %
Length of longest watercourse = 9.469 km
Flow of water = Defined water course
Height difference along 10-85 slope = 132.5 m
Area distribution = Rural: 5 %, Urban: 95 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns	Residential and industry	Business
Sandy, flat (<2%) 2	Houses 50	City centre 0
Sandy, steep (>7%) 1	Flats 20	Suburban 0
Heavy soil, flat (<2%) 2	Light industry 12	Streets 10
Heavy soil, steep (>7%) 1	Heavy industry 2	Maximum flood 0

Catchment description - Rural area (%)

Surface slopes	Permeability	Vegetation
Lakes and pans 15	Very permeable 20	Thick bush & forests 5
Flat area 80	Permeable 70	Light bush & cultivated land 20
Hilly 4	Semi-permeable 5	Grasslands 74
Steep areas 1	Impermeable 5	Bare 1

Days on which thunder was heard = 60 days/year

Weather Services station number = 513382

Weather Services station location = IRENE

Mean annual precipitation (MAP) = 660 mm

Duration 2 5 10 20 50 100 200

1 day 56 78 99 123 151 177 207

2 days 69 97 119 142 176 205 236

3 days 78 110 134 161 200 233 269

7 days 104 152 189 229 288 338 393

The modified recalibrated Hershfield relationship was used to determine point rainfall.

Average slope = 0.01866 m/m

Time of concentration = 1.73 h

Run-off factor

Rural - C1 = 0.345

Urban - C2 = 0.610

Lakes - C3 = 0.000

Combined - C = 0.597

Return period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.73	31.79	96.3	17.65	0.75	59.2	94.87
1:5	1.73	53.64	96.3	29.78	0.80	59.3	160.27
1:10	1.73	70.16	96.3	38.96	0.85	59.4	209.95
1:20	1.73	86.68	96.3	48.13	0.90	59.5	259.77
1:50	1.73	108.52	96.3	60.26	0.95	59.6	325.70
1:100	1.73	125.05	96.3	69.43	1.00	59.7	375.83
1:200	1.73	141.57	96.3	78.61	1.00	59.7	425.49

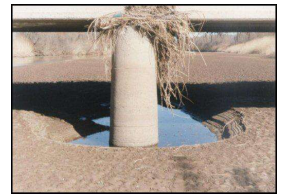
Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

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Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: Kosmosdal X102
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\K2914_2025_06_
Date: 2 June 2025

Printed: 19 June 2025

Page 1

Flood Frequency Analysis: Empirical methods

Project = Kosmosdal X102
Analysed by = LT BOWMAN
Name of river = Rietspruit
Description of site = Kosmosdal X102
Date = 6/2/2025

Area of catchment = 32.66 km²
Length of longest watercourse = 9.469 km
Height difference along equal-area slope = 132.5 m
Distance to catchment centroid = 4.003 km
Dolomitic area = 0.0 %
Mean annual rainfall = 683.0 mm
Veld type = 2 - All year
Kovács region = K5 (K = 5.0)
Catchment parameter with regard to reaction time = 0.102

Peak discharges by means of an empirical method developed by Midgley and Pitman

Return period (years)	KT constant	Peak flow (m ³ /s)
1:10	0.83	109.62
1:20	1.04	137.36
1:50	1.36	179.63
1:100	1.60	211.32

This RMF calculation includes a transition zone adjustment in the case of small catchments.

Regional maximum flood: 571.5 m³/s

Q50 (RMF): 236.96 m³/s (based on QT/QRMF relationship for Kovács regions)
Q100 (RMF): 297.03 m³/s (based on QT/QRMF relationship for Kovács regions)
Q200 (RMF): 362.86 m³/s (based on QT/QRMF relationship for Kovács regions)

The following equivalent maxima make no transition zone adjustments for small catchments.

Equivalent southern African maximum
K-factor 5.6: 1400 m³/s

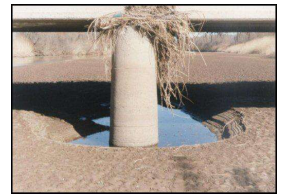
Equivalent world maxima
K-factor 6.0: 2545 m³/s
K-factor 6.3: 3983 m³/s

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: Kosmosdal X102
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\K2914_2025_06_
Date: 2 June 2025

Printed: 19 June 2025

Page 1

Flood frequency analysis : Standard Design Flood method

Project name = Kosmosdal X102
 Analysed by = LT BOWMAN
 Name of river = Rietspruit
 Description of site = Kosmosdal X102
 Date = 02 Jun 2025
 Catchment characteristics:
 Area of catchment = 32.66 km²
 Length of longest watercourse = 9.469 km
 1085 height difference = 132.5 m
 Average slope = 0.0187 m/m
 Drainage basin characteristics:
 Drainage basin number = 1
 Mean annual daily max rain = 56 mm
 Days on which thunder was heard = 30 days
 Runoff coefficient C2 = 10 %
 Runoff coefficient C100 = 40 %
 Basin mean annual precipitation = 550 mm
 Basin mean annual evaporation = 1800 mm
 Basin evaporation index MAE/MAP = 3.27

RAINFALL DATA

The rainfall data in the table below are derived from two sources. The daily rainfall is from the Department of Water Affairs' publication TR102 for the representative site. The modified Hershfield equation is used for durations up to four hours. Linear interpolation is used for values between 4 hours and one day.

Weather Services station ex TR102 = 546204 @ STRUAN
 Point mean annual precipitation = 550 mm

Dur:	RP =2	5	10	20	50	100	200
.25 h	15	25	33	41	51	59	67
.50 h	20	33	43	53	67	77	87
1 h	24	41	53	66	82	95	107
2 h	29	48	63	78	98	113	127
4 h	33	56	73	90	113	130	148
1 day	56	80	99	119	150	177	206
2 days	71	105	132	161	205	243	286
3 days	80	117	146	177	224	263	308
7 days	102	154	196	242	310	369	435

Runoff coefficients C2 = 10 % C100 = 40 %

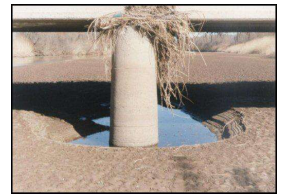
Return period (years)	Time of concentration (hours)	Point precipitation (mm)	ARF (%)	Catchment precipitation (mm)	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.73	27.7	96.3	26.7	10.0	13.95
1:5	1.73	46.7	96.3	45.0	20.8	49.00
1:10	1.73	61.1	96.3	58.8	26.5	81.54
1:20	1.73	75.5	96.3	72.7	31.1	118.38
1:50	1.73	94.5	96.3	91.0	36.4	173.35
1:100	1.73	108.9	96.3	104.8	40.0	219.53
1:200	1.73	123.2	96.3	118.7	43.2	268.53

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Kosmosdal X102
Analysed by: LT BOWMAN
Name of river: Rietspruit
Description of site: Kosmosdal X102
Filename: W:\CC-Projects\C PROJECTS\C3530 (LZ) KOSMOSDAL EXT 102 (K2914)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Hydrological\Run-off Calculations\K2914_2025_06_
Date: 2 June 2025

Printed: 19 June 2025

Page 2

Flood Frequency Analysis: Unit Hydrograph Method

Project = Kosmosdal X102
 Analysed by = LT BOWMAN
 Name of river = Rietspruit
 Description of site = Kosmosdal X102
 Date = 6/2/2025
 Area of catchment = 32.66 km²
 Length of longest watercourse = 9.469 km
 Height difference along equal area slope = 132.5 m
 Distance to catchment centroid = 4.003 km
 Veld type = Region 4
 Duration interval = 5 minutes

Slope of longest stream = 0.0140 m/m
 Catchment index = 320.4
 Catchment lag = 2.611
 Coefficient (Ku) = 0.386 m³/s - hours/km²
 Peak discharge of unit hydrograph (Qp) = 4.828 m³/s

Return period = 1:2 year

Storm duration (minutes)	Point rainfall (mm)	Point intensity (mm/h)	ARF (%)	Average rainfall (mm)	Runoff factor (%)	Effective rain (mm)
5	10.2	121.8	86.9	8.8	6.7	0.59
10	14.4	86.7	90.7	13.1	9.5	1.25
15	18.4	73.5	92.1	16.9	11.8	2.00
20	21.3	64.0	93.1	19.9	13.3	2.65
25	23.7	56.8	93.9	22.2	14.5	3.22
30	25.6	51.1	94.5	24.1	15.4	3.71
35	27.1	46.5	95.0	25.8	16.1	4.15
40	28.5	42.7	95.4	27.2	16.7	4.54
45	29.6	39.5	95.7	28.4	17.2	4.88
50	30.7	36.8	96.0	29.4	17.6	5.19
55	31.6	34.4	96.3	30.4	18.0	5.48
60	32.4	32.4	96.5	31.3	18.3	5.74
65	33.1	30.6	96.7	32.0	18.6	5.97
70	33.8	29.0	96.9	32.8	18.9	6.20
75	34.4	27.5	97.0	33.4	19.2	6.40
80	35.0	26.3	97.2	34.0	19.4	6.59
85	35.5	25.1	97.3	34.6	19.6	6.77
90	36.0	24.0	97.4	35.1	19.8	6.94
95	36.5	23.0	97.5	35.6	20.0	7.10
100	36.9	22.2	97.6	36.0	20.1	7.25
105	37.3	21.3	97.7	36.5	20.3	7.39
110	37.7	20.6	97.8	36.9	20.4	7.53
115	38.1	19.9	97.9	37.3	20.6	7.66
120	38.4	19.2	97.9	37.6	20.7	7.78
125	38.8	18.6	98.0	38.0	20.8	7.90
130	39.1	18.0	98.1	38.3	20.9	8.01
135	39.4	17.5	98.1	38.6	21.0	8.12
140	39.7	17.0	98.2	38.9	21.1	8.23
145	39.9	16.5	98.2	39.2	21.2	8.33
150	40.2	16.1	98.3	39.5	21.3	8.42
155	40.5	15.7	98.3	39.8	21.4	8.52
160	40.7	15.3	98.4	40.0	21.5	8.61
165	40.9	14.9	98.4	40.3	21.6	8.70
170	41.2	14.5	98.4	40.5	21.7	8.78
175	41.4	14.2	98.5	40.8	21.7	8.86
180	41.6	13.9	98.5	41.0	21.8	8.94
185	41.8	13.6	98.5	41.2	21.9	9.02
190	42.0	13.3	98.6	41.4	22.0	9.09
195	42.2	13.0	98.6	41.6	22.0	9.17
200	42.4	12.7	98.6	41.8	22.1	9.24
205	42.6	12.5	98.7	42.0	22.2	9.31

2645	0.047	26.731
2650	0.047	26.691
2655	0.047	26.651
2660	0.047	26.611
2665	0.047	26.571
2670	0.047	26.532
2675	0.046	26.492
2680	0.046	26.453
2685	0.046	26.413
2690	0.046	26.374
2695	0.046	26.335
2700	0.046	26.296
2705	0.046	26.258
2710	0.046	26.219
2715	0.046	26.181
2720	0.046	26.142
2725	0.046	26.104
2730	0.045	26.066
2735	0.045	26.028
2740	0.045	25.990
2745	0.045	25.952
2750	0.045	25.915
2755	0.045	25.877
2760	0.045	25.840
2765	0.045	25.803
2770	0.045	25.766
2775	0.045	25.729
2780	0.045	25.692
2785	0.045	25.655
2790	0.045	25.618
2795	0.044	25.582
2800	0.044	25.545
2805	0.044	25.509
2810	0.044	25.473
2815	0.044	25.437
2820	0.044	25.401
2825	0.044	25.365
2830	0.044	25.329
2835	0.044	25.294
2840	0.044	25.258
2845	0.044	25.223
2850	0.044	25.187
2855	0.043	25.152
2860	0.043	25.117
2865	0.043	25.082
2870	0.043	25.047
2875	0.043	25.013
2880	0.043	24.978

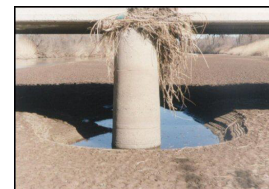
Return period	Storm duration (minutes)	Peak discharge (m ³ /s)
1:2 year	30	30.43
1:5 year	30	49.31
1:10 year	35	70.04
1:20 year	35	94.84
1:50 year	90	139.16
1:100 year	90	188.23

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Data Center
Analysed by: JP Welman
Name of river: Tributary of Rietspruit
Description of site: Kosmosdal 99&100
Filename: W:\CC-Projects\C PROJECTS\C3456 (LZ) KOSMOSDAL EXT 99 & 100 CDC CENTRAL (K2 962)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Catchment B.fld
Date: 29 May 2025

Printed: 29 May 2025

Page 1

Flood Frequency Analysis: Rational Method 1

Project = Data Center
 Analysed by = JP Welman
 Name of river = Tributary of Rietspruit
 Description of site = Kosmosdal 99&100
 Date = 2025/05/29
 Area of catchment = 5.852 km²
 Dolomitic area = 0.0 %
 Mean annual rainfall (MAR) = 660.00 mm
 Length of longest watercourse = 5.7 km
 Flow of water = Defined water course
 Height difference along 10-85 slope = 90.0 m
 Rainfall region = Inland
 Area distribution = Rural: 10 %, Urban: 90 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry	Business	
Sandy, flat (<2%)	5	Houses	10	City centre 0
Sandy, steep (>7%)	0	Flats	0	Suburban 0
Heavy soil, flat (<2%)	0	Light industry	75	Streets 10
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood 0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	20	Very permeable	40	Thick bush & forests	20
Flat area	80	Permeable	40	Light bush & cultivated land	80
Hilly	0	Semi-permeable	20	Grasslands	0
Steep areas	0	Impermeable	0	Bare	0

Average slope = 0.02105 m/m

Time of concentration = 1.12 h

Run-off factor

Rural - C1 = 0.246

Urban - C2 = 0.720

Lakes - C3 = 0.000

Combined - C = 0.673

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.12	32.5	99.5	28.9	0.75	66.6	31.26
1:5	1.12	44.2	99.4	39.2	0.80	66.8	42.58
1:10	1.12	56.0	99.2	49.6	0.85	66.9	53.89
1:20	1.12	69.1	99.0	61.1	0.90	67.0	66.53
1:50	1.12	89.8	98.7	79.2	0.95	67.1	86.39
1:100	1.12	110.5	98.4	97.1	1.00	67.3	106.21

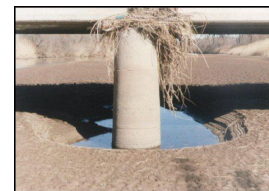
Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Data Center
Analysed by: JP Welman
Name of river: Tributary of Rietspruit
Description of site: Kosmosdal 99&100
Filename: W:\CC-Projects\C PROJECTS\C3456 (LZ) KOSMOSDAL EXT 99 & 100 CDC CENTRAL (K2 962)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Catchment B.fld
Date: 29 May 2025

Printed: 29 May 2025

Page 1

Flood Frequency Analysis: Rational Method 2

Project = Data Center
 Analysed by = JP Welman
 Name of river = Tributary of Rietspruit
 Description of site = Kosmosdal 99&100
 Date = 2025/05/29
 Area of catchment = 5.852 km²
 Dolomitic area = 0.0 %
 Length of longest watercourse = 5.7 km
 Flow of water = Defined water course
 Height difference along 10-85 slope = 90.0 m
 Area distribution = Rural: 10 %, Urban: 90 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns	Residential and industry	Business
Sandy, flat (<2%) 5	Houses 10	City centre 0
Sandy, steep (>7%) 0	Flats 0	Suburban 0
Heavy soil, flat (<2%) 0	Light industry 75	Streets 10
Heavy soil, steep (>7%) 0	Heavy industry 0	Maximum flood 0

Catchment description - Rural area (%)

Surface slopes	Permeability	Vegetation
Lakes and pans 20	Very permeable 40	Thick bush & forests 20
Flat area 80	Permeable 40	Light bush & cultivated land 80
Hilly 0	Semi-permeable 20	Grasslands 0
Steep areas 0	Impermeable 0	Bare 0

Days on which thunder was heard = 60 days/year

Weather Services station number = 513382

Weather Services station location = IRENE

Mean annual precipitation (MAP) = 660 mm

Duration 2 5 10 20 50 100 200

1 day 56 78 99 123 151 177 207

2 days 69 97 119 142 176 205 236

3 days 78 110 134 161 200 233 269

7 days 104 152 189 229 288 338 393

The modified recalibrated Hershfield relationship was used to determine point rainfall.

Average slope = 0.02105 m/m

Time of concentration = 1.12 h

Run-off factor

Rural - C1 = 0.246

Urban - C2 = 0.750

Lakes - C3 = 0.000

Combined - C = 0.700

Return period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.12	28.51	100.0	25.45	0.75	69.3	28.69
1:5	1.12	48.10	100.0	42.94	0.80	69.5	48.49
1:10	1.12	62.92	100.0	56.17	0.85	69.6	63.54
1:20	1.12	77.74	100.0	69.40	0.90	69.7	78.65
1:50	1.12	97.32	100.0	86.89	0.95	69.8	98.64
1:100	1.12	112.14	100.0	100.12	1.00	70.0	113.86
1:200	1.12	126.96	100.0	113.34	1.00	70.0	128.90

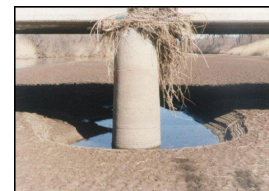
Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Data Center
Analysed by: JP Welman
Name of river: Tributary of Rietspruit
Description of site: Kosmosdal 99&100
Filename: W:\CC-Projects\C PROJECTS\C3456 (LZ) KOSMOSDAL EXT 99 & 100 CDC CENTRAL (K2 962)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Catchment B.fld
Date: 29 May 2025

Printed: 29 May 2025

Page 1

Flood Frequency Analysis: Empirical methods

Project = Data Center
 Analysed by = JP Welman
 Name of river = Tributary of Rietspruit
 Description of site = Kosmosdal 99&100
 Date = 2025/05/29

Area of catchment = 5.852 km²
 Length of longest watercourse = 5.7 km
 Height difference along equal-area slope = 96.0 m
 Distance to catchment centroid = 1.947 km
 Dolomitic area = 0.0 %
 Mean annual rainfall = 660.0 mm
 Veld type = 4 & 5A
 Kovács region = K5 (K = 5.0)
 Catchment parameter with regard to reaction time = 0.068

Peak discharges by means of an empirical method developed by Midgley and Pitman

Return period (years)	KT constant	Peak flow (m ³ /s)
1:10	0.59	24.78
1:20	0.68	28.56
1:50	0.95	39.91
1:100	1.20	50.41

This RMF calculation includes a transition zone adjustment in the case of small catchments.

Regional maximum flood: 241.9 m³/s

Q50 (RMF): 108.13 m³/s (based on QT/QRMF relationship for Kovács regions)
 Q100 (RMF): 133.05 m³/s (based on QT/QRMF relationship for Kovács regions)
 Q200 (RMF): 159.90 m³/s (based on QT/QRMF relationship for Kovács regions)

The following equivalent maxima make no transition zone adjustments for small catchments.

Equivalent southern African maximum
 K-factor 5.6: 657 m³/s

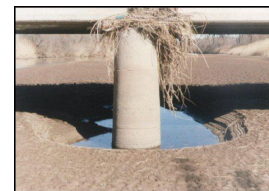
Equivalent world maxima
 K-factor 6.0: 1279 m³/s
 K-factor 6.3: 2108 m³/s

Calculated using Utility Programs for Drainage 2.0.0

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Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Data Center
Analysed by: JP Welman
Name of river: Tributary of Rietspruit
Description of site: Kosmosdal 99&100
Filename: W:\CC-Projects\C PROJECTS\C3456 (LZ) KOSMOSDAL EXT 99 & 100 CDC CENTRAL (K2 962)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Catchment B.fld
Date: 29 May 2025

Printed: 29 May 2025

Page 1

Flood frequency analysis : Standard Design Flood method

Project name	= Data Center
Analysed by	= JP Welman
Name of river	= Tributary of Rietspruit
Description of site	= Kosmosdal 99&100
Date	= 2025/05/29
Catchment characteristics:	
Area of catchment	= 5.852107 km ²
Length of longest watercourse	= 5.7 km
1085 height difference	= 90 m
Average slope	= 0.0211 m/m
Drainage basin characteristics:	
Drainage basin number	= 1
Mean annual daily max rain	= 56 mm
Days on which thunder was heard	= 30 days
Runoff coefficient C2	= 10 %
Runoff coefficient C100	= 40 %
Basin mean annual precipitation	= 550 mm
Basin mean annual evaporation	= 1800 mm
Basin evaporation index MAE/MAP	= 3.27

RAINFALL DATA

The rainfall data in the table below are derived from two sources. The daily rainfall is from the Department of Water Affairs's publication TR102 for the representative site. The modified Hershfield equation is used for durations up to four hours. Linear interpolation is used for values between 4 hours and one day.

Weather Services station ex TR102 = 546204 @ STRUAN
 Point mean annual precipitation = 550 mm

Dur:	RP =2	5	10	20	50	100	200
.25 h	15	25	33	41	51	59	67
.50 h	20	33	43	53	67	77	87
1 h	24	41	53	66	82	95	107
2 h	29	48	63	78	98	113	127
4 h	33	56	73	90	113	130	148
1 day	56	80	99	119	150	177	206
2 days	71	105	132	161	205	243	286
3 days	80	117	146	177	224	263	308
7 days	102	154	196	242	310	369	435

Runoff coefficients C2 = 10 % C100 = 40 %

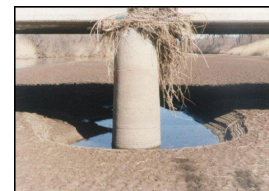
Return period (years)	Time of concentration (hours)	Point precipitation (mm)	ARF (%)	Catchment precipitation (mm)	Runoff coefficient (%)	Peak flow (m ³ /s)
1:2	1.12	24.8	100.0	24.8	10.0	3.605
1:5	1.12	41.9	100.0	41.9	20.8	12.66
1:10	1.12	54.8	100.0	54.8	26.5	21.07
1:20	1.12	67.7	100.0	67.7	31.1	30.58
1:50	1.12	84.7	100.0	84.7	36.4	44.79
1:100	1.12	97.6	100.0	97.6	40.0	56.72
1:200	1.12	110.5	100.0	110.5	43.2	69.38

Calculated using Utility Programs for Drainage 2.0.0

The software programs were developed for the convenience of its users. Although every reasonable effort has been made to ensure that the programs are accurate and reliable the program developers, Sinotech CC, accept no liability of any kind for any results, interpretation thereof or any use made of the results obtained with these programs. All users of these programs do so entirely at

Utility Programs for Drainage

Flood calculations



Sinotech

Project name: Data Center
Analysed by: JP Welman
Name of river: Tributary of Rietspruit
Description of site: Kosmosdal 99&100
Filename: W:\CC-Projects\C PROJECTS\C3456 (LZ) KOSMOSDAL EXT 99 & 100 CDC CENTRAL (K2 962)\1. Client and Related Bodies\1.11 Hydrology, SIA, SMP's\Catchment B.fld
Date: 29 May 2025

Printed: 29 May 2025

Page 1

Flood Frequency Analysis: Unit Hydrograph Method

Project = Data Center
 Analysed by = JP Welman
 Name of river = Tributary of Rietspruit
 Description of site = Kosmosdal 99&100
 Date = 2025/05/29
 Area of catchment = 5.852 km²
 Length of longest watercourse = 5.7 km
 Height difference along equal area slope = 96.0 m
 Distance to catchment centroid = 1.947 km
 Veld type = Region 4
 Duration interval = 30 minutes

Slope of longest stream = 0.0168 m/m
 Catchment index = 85.5
 Catchment lag = 1.614
 Coefficient (Ku) = 0.386 m³/s - hours/km²
 Peak discharge of unit hydrograph (Qp) = 1.399 m³/s

Return period = 1:2 year

Storm duration (minutes)	Point rainfall (mm)	Point intensity (mm/h)	ARF (%)	Average rainfall (mm)	Runoff factor (%)	Effective rain (mm)
30	24.8	49.6	99.2	24.6	15.6	3.84
60	31.5	31.5	99.5	31.3	18.4	5.75
90	35.0	23.3	99.6	34.9	19.7	6.86
120	37.3	18.7	99.7	37.2	20.5	7.64
150	39.0	15.6	99.8	38.9	21.1	8.23
180	40.4	13.5	99.8	40.3	21.6	8.71
210	41.5	11.9	99.8	41.4	22.0	9.11
240	42.5	10.6	99.8	42.4	22.3	9.45
270	43.3	9.6	99.8	43.2	22.6	9.75
300	44.0	8.8	99.9	44.0	22.8	10.02
330	44.7	8.1	99.9	44.6	23.0	10.27
360	45.3	7.5	99.9	45.2	23.2	10.49
390	45.8	7.1	99.9	45.8	23.4	10.70
420	46.3	6.6	99.9	46.3	23.5	10.89
450	46.8	6.2	99.9	46.8	23.7	11.07
480	47.2	5.9	99.9	47.2	23.8	11.23
510	47.7	5.6	99.9	47.6	23.9	11.39
540	48.0	5.3	99.9	48.0	24.0	11.54
570	48.4	5.1	99.9	48.4	24.2	11.68
600	48.7	4.9	99.9	48.7	24.3	11.81
630	49.1	4.7	99.9	49.0	24.4	11.94
660	49.4	4.5	99.9	49.3	24.4	12.06
690	49.7	4.3	99.9	49.6	24.5	12.18
720	50.0	4.2	99.9	49.9	24.6	12.30
750	50.2	4.0	99.9	50.2	24.7	12.40
780	50.5	3.9	99.9	50.5	24.8	12.51
810	50.8	3.8	99.9	50.7	24.9	12.61
840	51.0	3.6	99.9	51.0	24.9	12.71
870	51.2	3.5	99.9	51.2	25.0	12.80
900	51.5	3.4	99.9	51.4	25.1	12.89
930	51.7	3.3	99.9	51.7	25.1	12.98
960	51.9	3.2	99.9	51.9	25.2	13.07
990	52.1	3.2	99.9	52.1	25.3	13.15
1020	52.3	3.1	100.0	52.3	25.3	13.24
1050	52.5	3.0	100.0	52.5	25.4	13.32
1080	52.7	2.9	100.0	52.7	25.4	13.39

1110	52.9	2.9	100.0	52.9	25.5	13.47
1140	53.1	2.8	100.0	53.0	25.5	13.54
1170	53.2	2.7	100.0	53.2	25.6	13.62
1200	53.4	2.7	100.0	53.4	25.6	13.69
1230	53.6	2.6	100.0	53.6	25.7	13.76
1260	53.7	2.6	100.0	53.7	25.7	13.82
1290	53.9	2.5	100.0	53.9	25.8	13.89
1320	54.1	2.5	100.0	54.0	25.8	13.95
1350	54.2	2.4	100.0	54.2	25.9	14.02
1380	54.4	2.4	100.0	54.3	25.9	14.08
1410	54.5	2.3	100.0	54.5	26.0	14.14
1440	54.7	2.3	100.0	54.6	26.0	14.20
1470	54.8	2.2	100.0	54.8	26.0	14.26
1500	54.9	2.2	100.0	54.9	26.1	14.32
1530	55.1	2.2	100.0	55.1	26.1	14.38
1560	55.2	2.1	100.0	55.2	26.2	14.43
1590	55.3	2.1	100.0	55.3	26.2	14.49
1620	55.5	2.1	100.0	55.4	26.2	14.54
1650	55.6	2.0	100.0	55.6	26.3	14.59
1680	55.7	2.0	100.0	55.7	26.3	14.65
1710	55.8	2.0	100.0	55.8	26.3	14.70
1740	56.0	1.9	100.0	55.9	26.4	14.75
1770	56.1	1.9	100.0	56.1	26.4	14.80
1800	56.2	1.9	100.0	56.2	26.4	14.85
1830	56.3	1.8	100.0	56.3	26.5	14.90
1860	56.4	1.8	100.0	56.4	26.5	14.95
1890	56.5	1.8	100.0	56.5	26.5	14.99
1920	56.6	1.8	100.0	56.6	26.6	15.04
1950	56.8	1.7	100.0	56.7	26.6	15.09
1980	56.9	1.7	100.0	56.8	26.6	15.13
2010	57.0	1.7	100.0	57.0	26.6	15.18
2040	57.1	1.7	100.0	57.1	26.7	15.22
2070	57.2	1.7	100.0	57.2	26.7	15.27
2100	57.3	1.6	100.0	57.3	26.7	15.31
2130	57.4	1.6	100.0	57.4	26.8	15.35
2160	57.5	1.6	100.0	57.5	26.8	15.39
2190	57.6	1.6	100.0	57.6	26.8	15.44
2220	57.7	1.6	100.0	57.7	26.8	15.48
2250	57.8	1.5	100.0	57.7	26.9	15.52
2280	57.9	1.5	100.0	57.8	26.9	15.56
2310	57.9	1.5	100.0	57.9	26.9	15.60
2340	58.0	1.5	100.0	58.0	26.9	15.64
2370	58.1	1.5	100.0	58.1	27.0	15.68
2400	58.2	1.5	100.0	58.2	27.0	15.71
2430	58.3	1.4	100.0	58.3	27.0	15.75
2460	58.4	1.4	100.0	58.4	27.0	15.79
2490	58.5	1.4	100.0	58.5	27.1	15.83
2520	58.6	1.4	100.0	58.6	27.1	15.86
2550	58.7	1.4	100.0	58.6	27.1	15.90
2580	58.7	1.4	100.0	58.7	27.1	15.94
2610	58.8	1.4	100.0	58.8	27.2	15.97
2640	58.9	1.3	100.0	58.9	27.2	16.01
2670	59.0	1.3	100.0	59.0	27.2	16.04
2700	59.1	1.3	100.0	59.0	27.2	16.08
2730	59.1	1.3	100.0	59.1	27.3	16.11
2760	59.2	1.3	100.0	59.2	27.3	16.15
2790	59.3	1.3	100.0	59.3	27.3	16.18
2820	59.4	1.3	100.0	59.4	27.3	16.21
2850	59.4	1.3	100.0	59.4	27.3	16.25
2880	59.5	1.2	100.0	59.5	27.4	16.28

Return period = 1:5 year

Storm duration (minutes)	Point rainfall (mm)	Point intensity (mm/h)	ARF (%)	Average rainfall (mm)	Runoff factor (%)	Effective rain (mm)
30	33.8	67.6	98.9	33.4	19.2	6.41
60	42.8	42.8	99.3	42.5	22.3	9.50
90	47.6	31.8	99.5	47.4	23.9	11.31
120	50.8	25.4	99.6	50.6	24.8	12.56
150	53.2	21.3	99.7	53.0	25.5	13.52
180	55.0	18.3	99.7	54.9	26.1	14.30
210	56.5	16.2	99.7	56.4	26.5	14.94
240	57.8	14.5	99.8	57.7	26.9	15.50
270	59.0	13.1	99.8	58.9	27.2	15.99
300	60.0	12.0	99.8	59.9	27.5	16.43
330	60.9	11.1	99.8	60.8	27.7	16.83
360	61.7	10.3	99.8	61.6	27.9	17.19
390	62.4	9.6	99.8	62.3	28.1	17.53
420	63.1	9.0	99.9	63.0	28.3	17.84
450	63.7	8.5	99.9	63.7	28.5	18.13
480	64.3	8.0	99.9	64.3	28.6	18.40
510	64.9	7.6	99.9	64.8	28.8	18.65
540	65.4	7.3	99.9	65.3	28.9	18.90
570	65.9	6.9	99.9	65.8	29.0	19.12

2160	0.037	5.671
2190	0.037	5.609
2220	0.036	5.548
2250	0.036	5.489
2280	0.035	5.431
2310	0.035	5.374
2340	0.034	5.319
2370	0.034	5.265
2400	0.034	5.212
2430	0.033	5.160
2460	0.033	5.110
2490	0.032	5.060
2520	0.032	5.012
2550	0.032	4.965
2580	0.031	4.918
2610	0.031	4.873
2640	0.030	4.828
2670	0.030	4.785
2700	0.030	4.742
2730	0.029	4.700
2760	0.029	4.659
2790	0.029	4.619
2820	0.029	4.579
2850	0.028	4.541
2880	0.028	4.502

Return period	Storm duration (minutes)	Peak discharge (m ³ /s)
1:2 year	30	7.684
1:5 year	30	12.82
1:10 year	30	18.75
1:20 year	30	26.19
1:50 year	30	39.49
1:100 year	30	54.50

Calculated using Utility Programs for Drainage 2.0.0

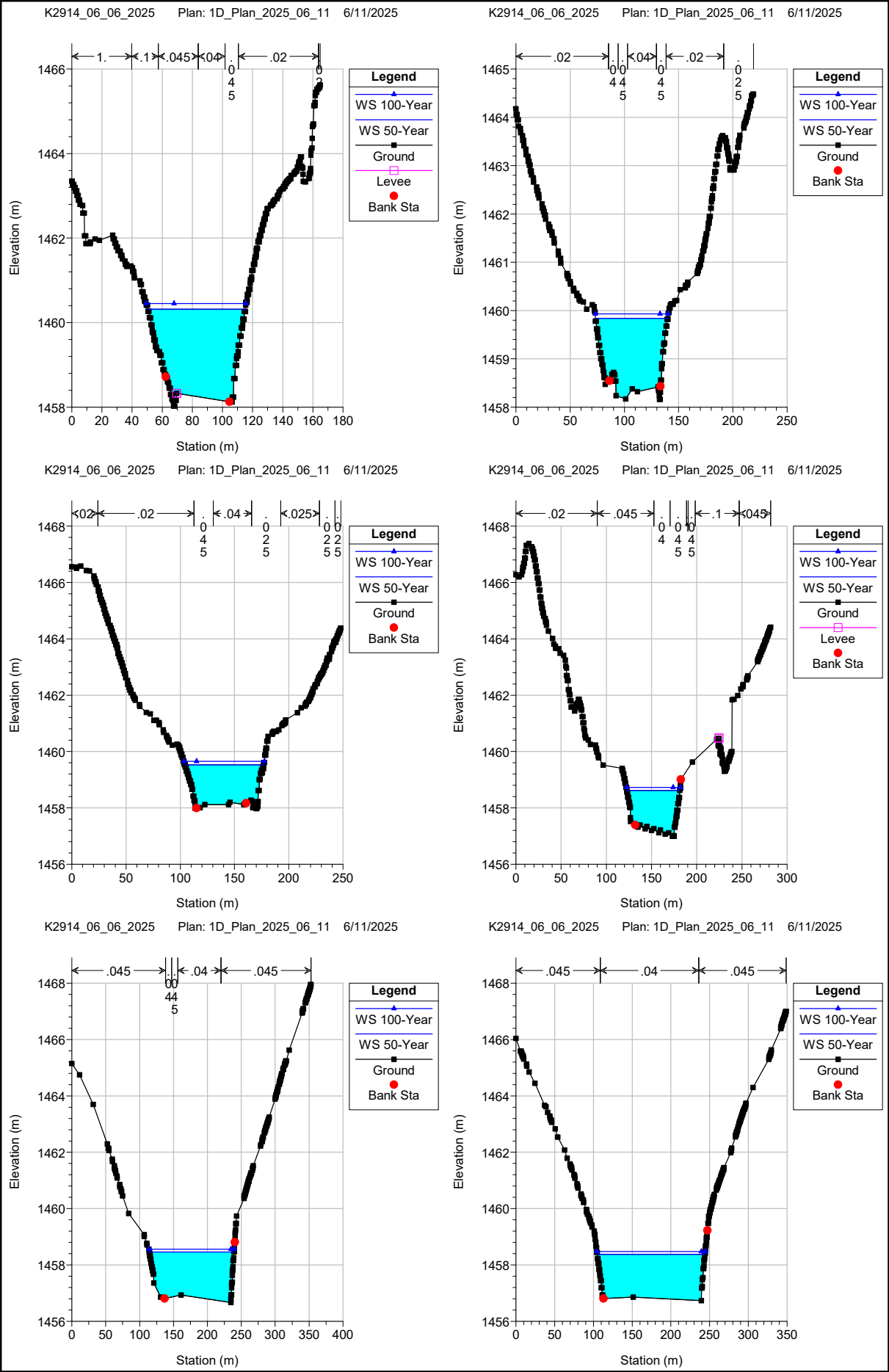
The software programs were developed for the convenience of its users. Although every reasonable effort has been made to ensure that the programs are accurate and reliable the program developers, Sinotech CC, accept no liability of any kind for any results, interpretation thereof or any use made of the results obtained with these programs. All users of these programs do so entirely at their own risk. Copyright (C) 2009 SINOTECH CC, www.sinotechcc.co.za, software@sinotechcc.co.za

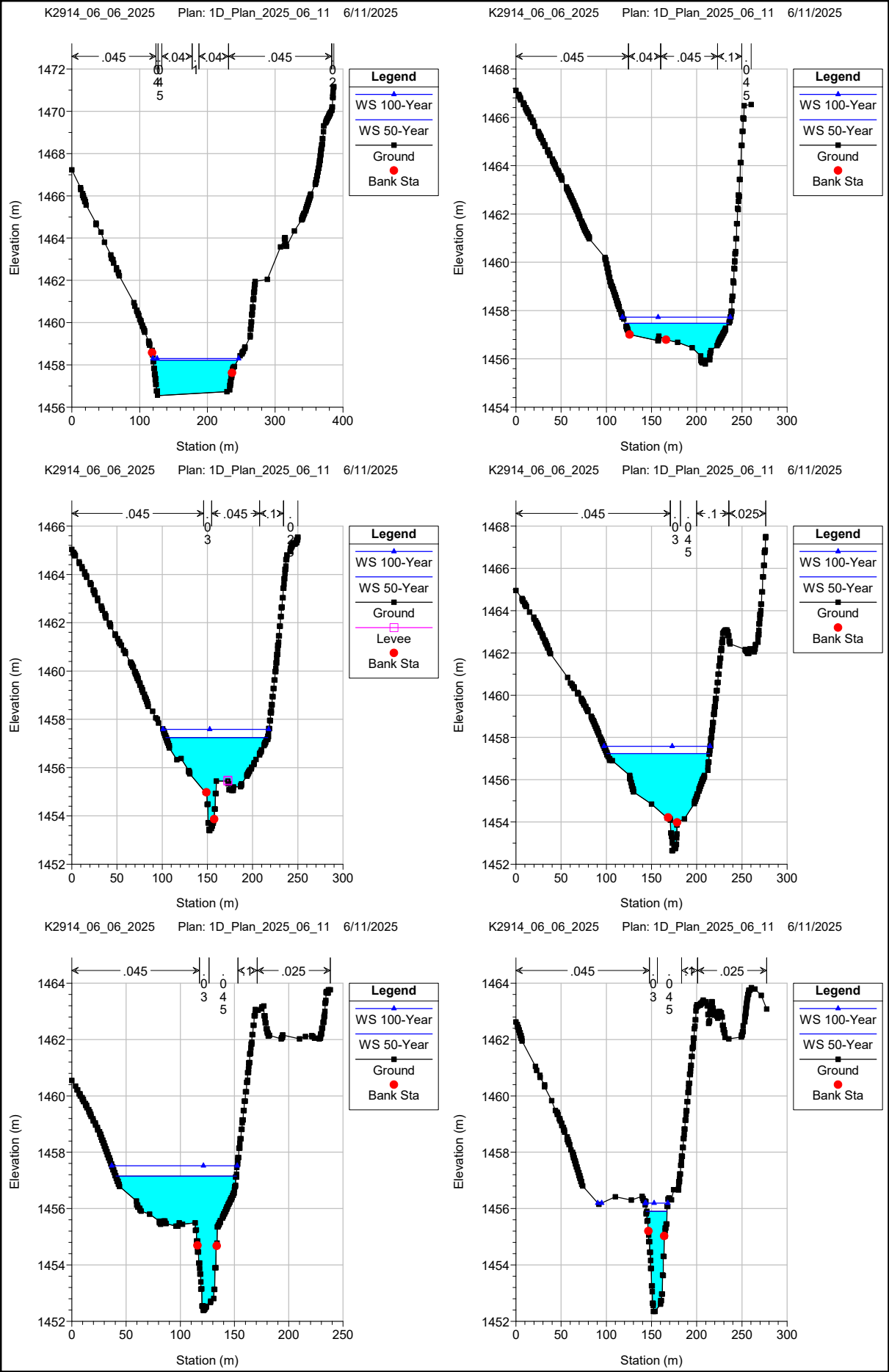


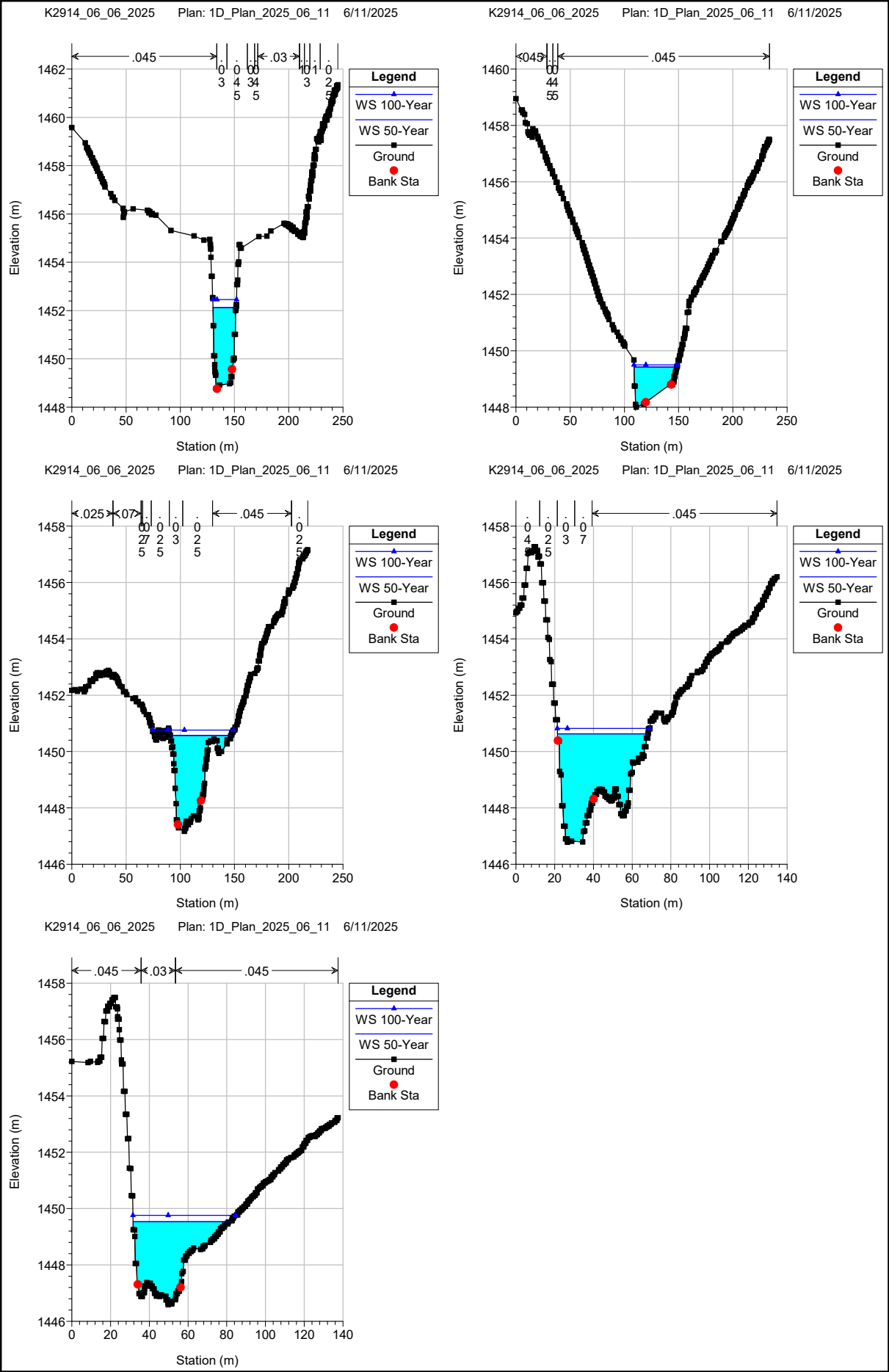
**FLOODLINE REPORT FOR
KOSMOSDAL EXT 102**

ANNEXURES

**ANNEXURE D
HEC-RAS CROSS SECTIONS**









**FLOODLINE REPORT FOR
KOSMOSDAL EXT 102**

ANNEXURES

**ANNEXURE E
HEC-RAS RESULTS**

HEC-RAS Plan: Run_1_25_06_11 River: K2914 Reach: K2914

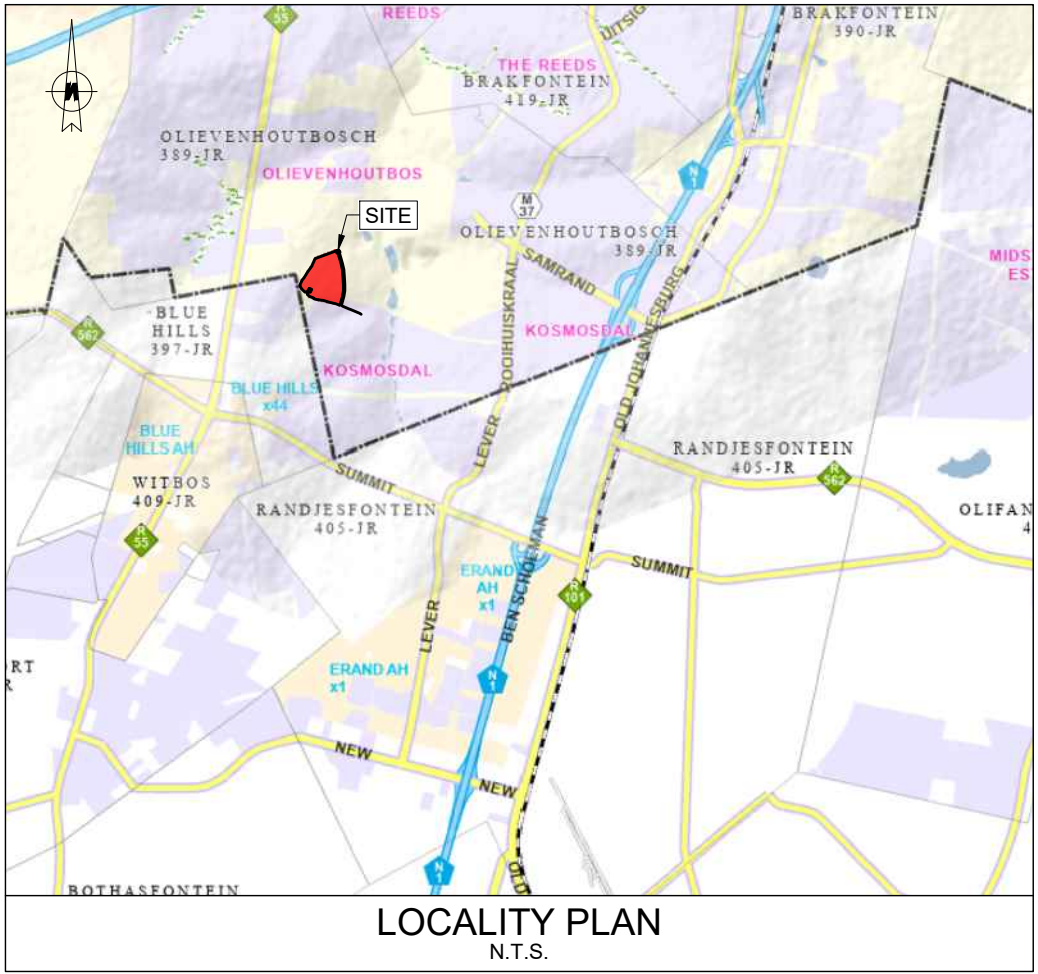
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Hydr Depth (m)	Vel Chnl (m/s)	Froude # Chl	Hydr Radius (m)	Mann Wtd Total
K2914	1100	50-Year	247.50	1458.03	1460.32	1.69	2.43	0.54	1.64	0.040
K2914	1100	100-Year	282.40	1458.03	1460.45	1.80	2.58	0.55	1.75	0.040
K2914	1051	50-Year	247.50	1458.16	1459.84	1.27	2.84	0.74	1.25	0.036
K2914	1051	100-Year	282.40	1458.16	1459.93	1.36	2.99	0.76	1.34	0.036
K2914	1006	50-Year	247.50	1458.00	1459.52	1.23	2.70	0.73	1.21	0.037
K2914	1006	100-Year	282.40	1458.00	1459.65	1.33	2.80	0.72	1.30	0.036
K2914	942	50-Year	247.50	1456.99	1458.62	1.25	3.51	0.97	1.22	0.042
K2914	942	100-Year	282.40	1456.99	1458.73	1.34	3.67	0.98	1.31	0.042
K2914	887	50-Year	247.50	1456.67	1458.46	1.52	1.35	0.34	1.51	0.041
K2914	887	100-Year	282.40	1456.67	1458.56	1.61	1.45	0.35	1.59	0.041
K2914	825	50-Year	247.50	1456.73	1458.38	1.50	1.20	0.31	1.49	0.040
K2914	825	100-Year	282.40	1456.73	1458.47	1.58	1.29	0.32	1.56	0.040
K2914	754	50-Year	247.50	1456.55	1458.23	1.44	1.39	0.36	1.42	0.046
K2914	754	100-Year	282.40	1456.55	1458.30	1.50	1.51	0.38	1.48	0.046
K2914	672	50-Year	247.50	1456.75	1457.48	0.79	2.35	0.97	0.79	0.042
K2914	672	100-Year	282.40	1456.75	1457.72	1.01	2.21	0.77	1.00	0.043
K2914	567	50-Year	247.50	1453.39	1457.24	1.56	2.43	0.42	1.52	0.038
K2914	567	100-Year	282.40	1453.39	1457.59	1.84	2.23	0.37	1.80	0.039
K2914	516	50-Year	247.50	1452.64	1457.23	2.03	1.88	0.30	1.99	0.038
K2914	516	100-Year	282.40	1452.64	1457.58	2.31	1.82	0.28	2.26	0.039
K2914	484	50-Year	247.50	1452.39	1457.16	1.73	1.99	0.31	1.67	0.036
K2914	484	100-Year	282.40	1452.39	1457.52	2.02	1.87	0.28	1.94	0.038
K2914	479	50-Year	247.50	1452.35	1455.90	2.22	5.01	0.96	1.85	0.034
K2914	479	100-Year	282.40	1452.35	1456.19	2.02	5.12	0.93	1.73	0.031
K2914	421	50-Year	247.50	1451.36	1454.44	0.84	6.27	1.39	0.81	0.026
K2914	421	100-Year	282.40	1451.36	1454.51	0.85	6.76	1.48	0.82	0.027
K2914	354	50-Year	247.50	1451.58	1454.56	1.07	3.52	0.76	1.05	0.038
K2914	354	100-Year	282.40	1451.58	1454.69	1.19	3.53	0.74	1.17	0.039
K2914	256	50-Year	247.50	1450.73	1454.01	1.26	3.41	0.67	1.24	0.038
K2914	256	100-Year	282.40	1450.73	1454.30	1.47	3.13	0.59	1.45	0.039
K2914	170	50-Year	247.50	1450.94	1453.72	1.30	2.64	0.56	1.29	0.042
K2914	170	100-Year	282.40	1450.94	1454.15	1.67	2.17	0.42	1.65	0.043
K2914	151	50-Year	290.90	1450.07	1453.70	1.80	2.42	0.43	1.76	0.039
K2914	151	100-Year	331.90	1450.07	1454.13	2.12	2.19	0.37	2.07	0.040
K2914	108	50-Year	290.90	1449.16	1453.75	2.74	1.36	0.21	2.56	0.037
K2914	108	100-Year	331.90	1449.16	1454.16	3.06	1.35	0.20	2.84	0.038
K2914	81	50-Year	290.90	1448.76	1452.12	2.75	5.76	1.03	2.29	0.032
K2914	81	100-Year	331.90	1448.76	1452.46	3.01	5.91	1.01	2.48	0.032
K2914	43	50-Year	290.90	1448.18	1449.42	0.95	7.51	2.50	0.92	0.043
K2914	43	100-Year	331.90	1448.18	1449.50	1.01	7.99	2.55	0.98	0.043
K2914	-17	50-Year	290.90	1447.17	1450.57	1.50	3.86	0.71	1.42	0.019
K2914	-17	100-Year	331.90	1447.17	1450.76	1.42	4.02	0.71	1.35	0.019
K2914	-62	50-Year	290.90	1446.78	1450.63	2.35	2.90	0.52	2.09	0.046
K2914	-62	100-Year	331.90	1446.78	1450.82	2.48	3.06	0.53	2.21	0.046
K2914	-139	50-Year	290.90	1446.59	1449.54	1.60	4.52	0.90	1.50	0.029
K2914	-139	100-Year	331.90	1446.59	1449.76	1.72	4.62	0.88	1.62	0.030



**FLOODLINE REPORT FOR
KOSMOSDAL EXT 102**

ANNEXURES

**ANNEXURE F
EXISTING FLOODLINES LAYOUT**



NOTES AND SPECIFICATIONS

- LEGEND:
- 1:50 YEAR FLOODLINE
 - 1:100 YEAR FLOODLINE
 - SPRUIT CENTRE LINE
 - 1:50 YEAR FLOODLINE - FUTURE
 - 1:100 YEAR FLOODLINE - FUTURE
 - STUDY AREA
 - EXISTING ROAD
 - FUTURE ROAD
 - FUTURE BRIDGE
 - CONTROL POINT

	C1	C2	C3
AREA (km²)	39.2	32.7	5.9
LONGEST WATERCOURSE (km)	9.7	9.5	5.7
DOLOMITIC AREA (%)	0	0	0
AVERAGE SLOPE (m/m)	0.0186	0.0187	0.0211
TIME OF CONCENTRATION (h)	1.77	1.73	1.12
C-FACTOR	0.600	0.600	0.573
IDF ZONE	C	C	C
RETURN PERIOD	50	100	50
PEAK FLOW (m³/s)	290.9	331.9	247.5

FLOODWATER:

THIS IS TO CERTIFY THAT THE 1:50 & 1:100 YEAR FLOODLINE AS SHOWN ON DRAWING NO. C3530-FL-001 IS IN ACCORDANCE WITH THE SPECIFICATIONS AS LAID DOWN BY ARTICLE 169A OF THE WATER ACT (ACT 54 OF 1956) AS AMENDED BY ARTICLE 18 OF THE WATER AMENDMENT ACT (ACT 73 OF 1978) AND ARTICLE 144 AND 145 OF THE NATIONAL WATER ACT (ACT 36 OF 1998)

PROFESSIONAL ENGINEER : J.P. WELMAN
REGISTRATION NO. : 20180172

SIGNATURE 19-06-2025
DATE

16-07-2025	B	UPDATED C2 AREA IN TABLE & UPDATED BRIDGE
29-04-2025	A	ISSUED FOR APPROVAL
DATE	NO	REVISION

CLIENT

CONSULTANT



Civil Concepts (Pty) Ltd
Consulting Civil & Structural Engineers
PO Box 36148, Menlo Park, 0102
Office: +27 12 460 0008
www.civilconcepts.co.za

PROJECT STATUS

- ☒ CONCEPT DRAWING ☐ TENDER DRAWING ☐ CONSTRUCTION DRAWING ☐ AS BUILT DRAWING

PROJECT ENGINEER (CONSULTANT)
J.P. WELMAN 20180172 16-07-2025
INITIALS AND SURNAME SIGNATURE AND P. No. DATE
INSPECTOR OF WORKS (MUNICIPAL):

INITIALS AND SURNAME SIGNATURE AND P. No. DATE
"AS BUILT DRAWING"

CC CONSULTING ENGINEER
INITIALS AND SURNAME SIGNATURE AND P. No. DATE

PROJECT
KOSMOSDAL EXT. 102

DRAWING TITLE
FLOODLINE LAYOUT

PROJECT NO	C3530-FL-002	REV. NO.	B
SCALE	1: 2000	DESIGNED	L. BOWMAN
DATE	JUNE 2025	DRAWN	R. WILLERS
		CHECKED	J.P. WELMAN



**FLOODLINE REPORT FOR
KOSMOSDAL EXT 102**

ANNEXURES

**ANNEXURE G
FUTURE SINGLE SPAN BRIDGE**

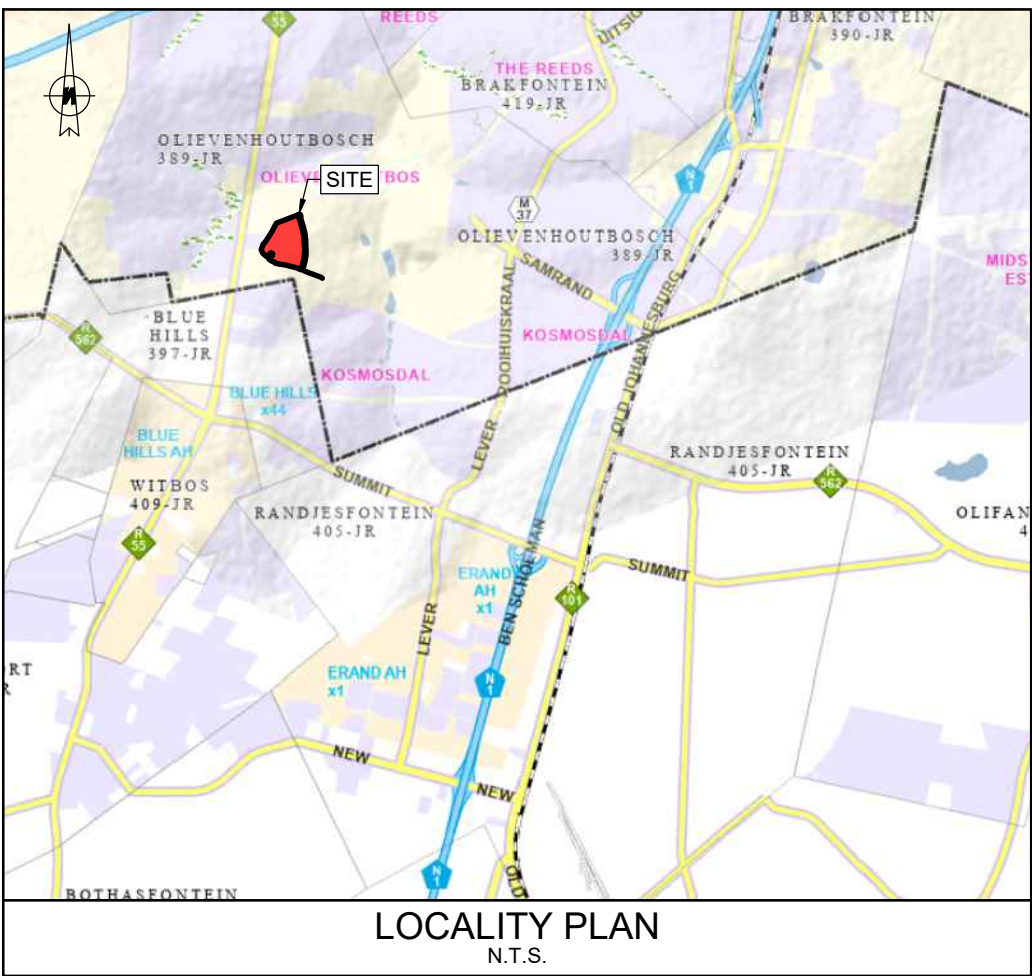
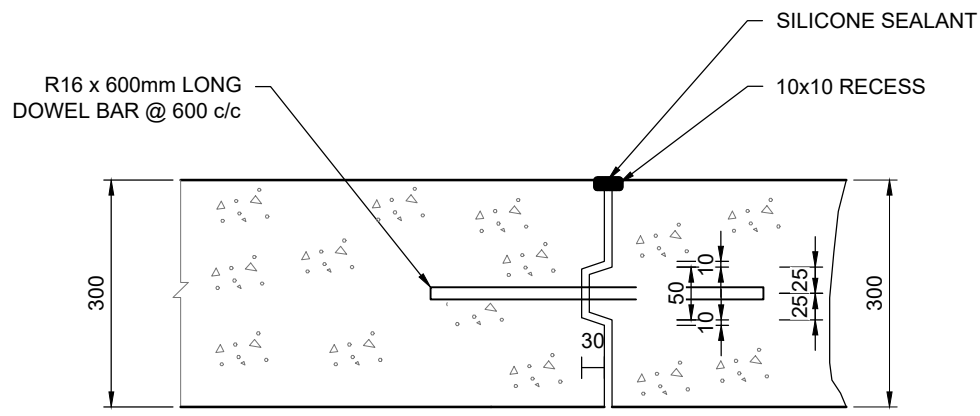
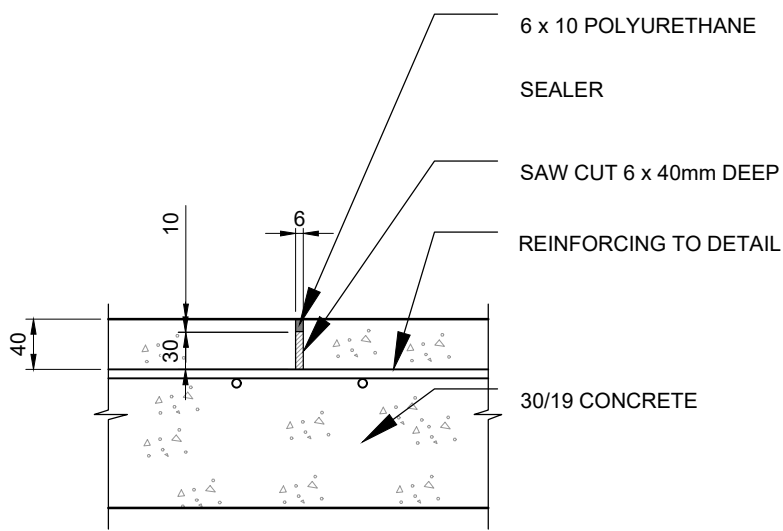


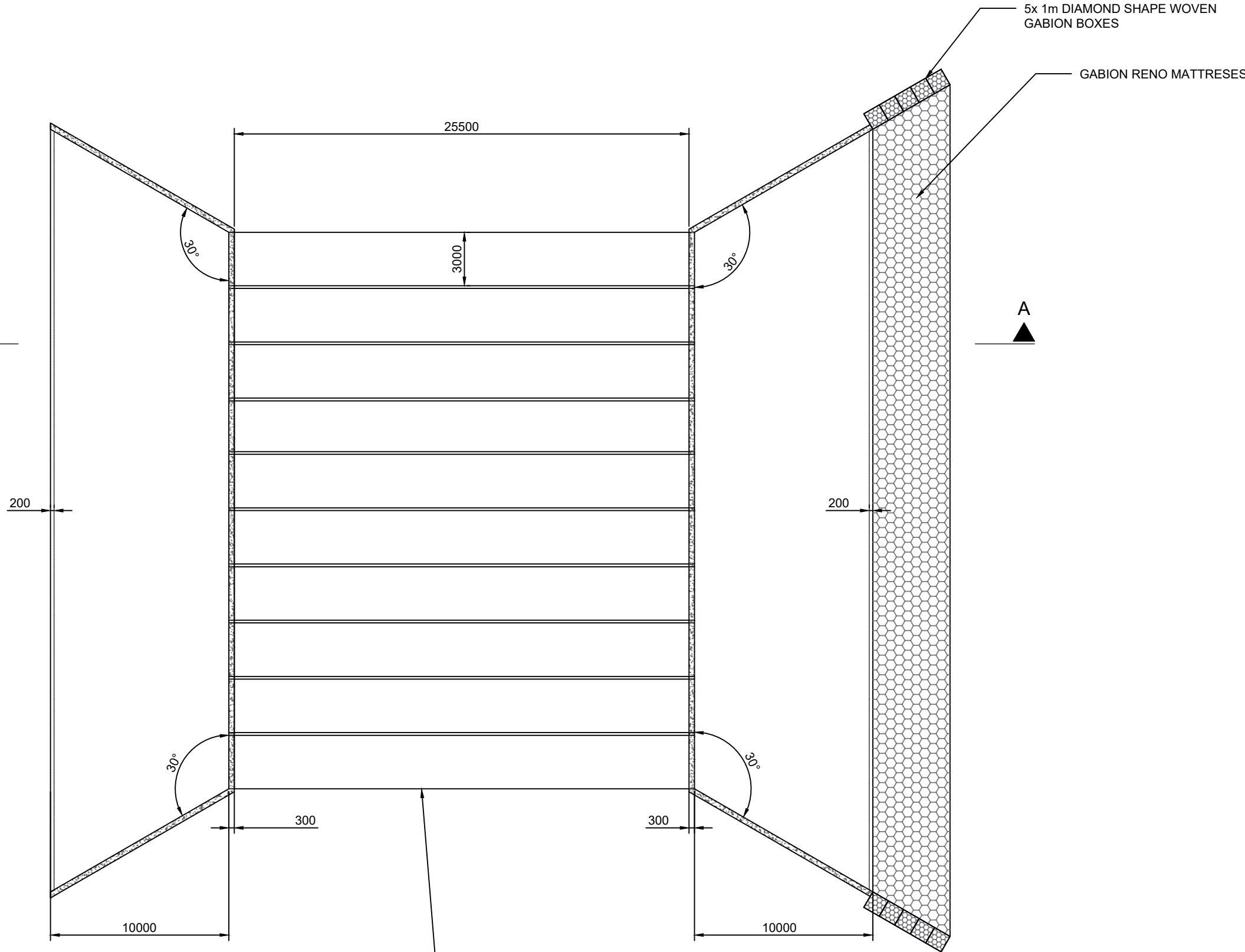
PHOTO 1
TYPICAL BOULDER CHANNEL +/- 1.5 YEARS
AFTER CONSTRUCTION COMPLETED
N.T.S



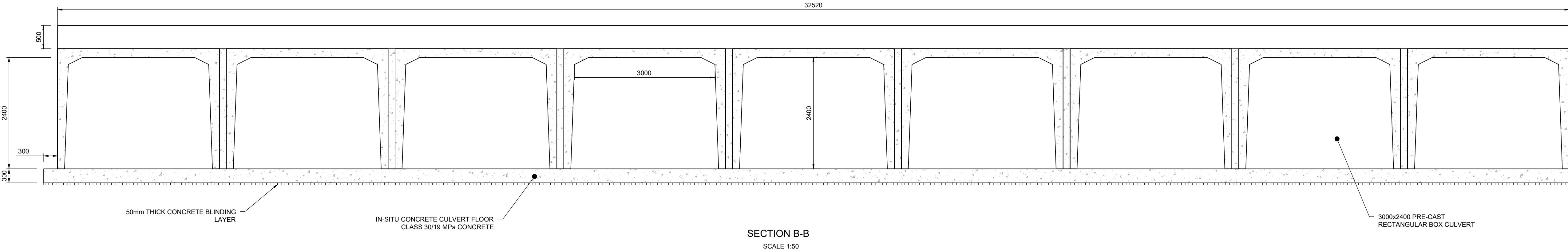
CONSTRUCTION JOINT DETAIL (C1)
N.T.S



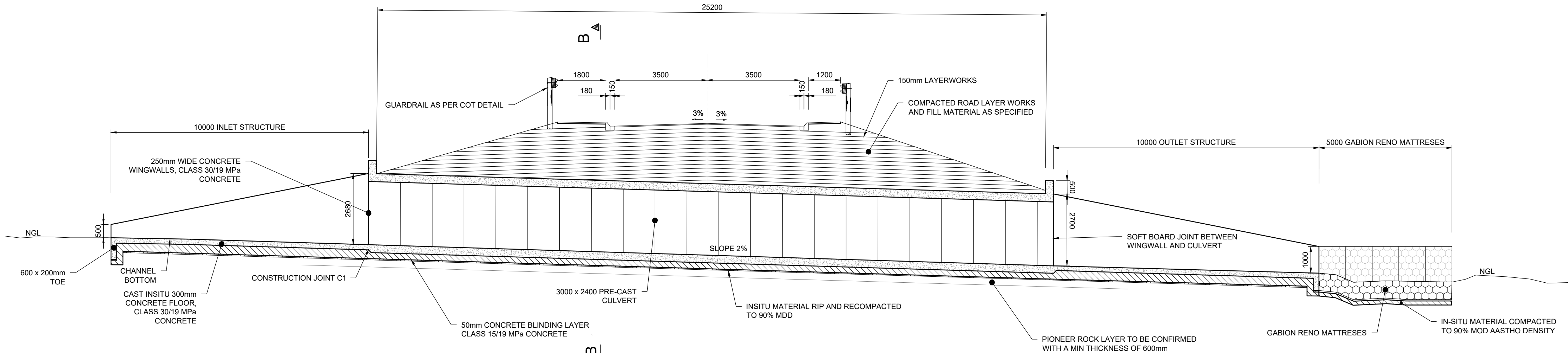
SAW JOINT DETAIL
N.T.S



PLAN VIEW
SCALE 1:250



SECTION B-B
SCALE 1:50



SECTION A-A
SCALE 1:100

HYDRAULIC DATA:

- DESIGN RECURRENT PERIOD: 1:50
- DESIGN FLOOD: 247.50 m³/s
- AVAILABLE HEADWATER (H_W): 4.5m
- CULVERT DESIGN: 10' 3000 BY 2400
- DESIGN FLOW PER OPENING: 24.7 m³/s
- CONTROL INLET
- OUTLET FLOW DEPTH: 1.85m
- OUTLET VELOCITY: 5m/s
- OUTLET FROUDE NO: 1.24m
- OUTLET JUMP DEPTH: 2.18m
- FREE BOARD: 1.4m

NOTES AND SPECIFICATIONS

GENERAL

- ALL CONSTRUCTION TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005, (UNLESS ANOTHER SPECIFICATION IS SPECIFIED IN THE CONTRACT).
- ALL DIMENSIONS ARE IN METERS, (UNLESS OTHERWISE SPECIFIED)
- DO NOT SCALE FROM THESE DRAWINGS.
- ALL DIMENSIONS MUST BE VERIFIED ON SITE.
- ALL THE SERVICES ARE SCHEMATIC AND MUST BE EXPOSED TO DETERMINE THEIR POSITION BEFORE CONSTRUCTION CAN COMMENCE.
- SERVICES INSIDE THE WORK AREA TO BE IDENTIFIED AND THE SERVICE OWNERS CONTACTED, AS PER THE PROJECT SPECIFICATIONS.
- THE LATEST STANDARD DRAWINGS OF COT ARE APPLICABLE TO THE WORKS.
- TRAFFIC CONTROL MUST COMPLY WITH THE REQUIREMENTS OF THE SOUTH AFRICAN ROAD TRAFFIC SIGNS MANUAL, (THIRD EDITION).
 - DURING CONSTRUCTION THE CONTRACTOR SHALL PREPARE TRAFFIC ACCOMMODATION DETAILS TO SUIT HIS WORKING METHODS TO BE AGREED WITH THE ENGINEER.
- ALL KERBS, TRANSITION SECTIONS AND PEDESTRIAN RAMP ACCORDING TO COT DETAIL DRAWINGS AND PRECAST SECTIONS SHALL CONFORM TO SANS 927.
- ALL PRECAST TACTILE BLOCKS SHALL CONFORM TO SANS 784.
- ALL MATERIAL AND WORKMANSHIP MUST COMPLY WITH THE REQUIREMENTS OF THE LATEST RELEVANT SABS REQUIREMENTS.
- CONSTRUCTION TOLERANCES SHALL BE AS SPECIFIED IN SABS 1200 LE.
- FINAL POSITION OF SERVICES TO BE DETERMINED ON SITE.

AMENDMENTS

NR.	DATE	APPROVED	DESCRIPTION	PAR.
A	19-02-2026	-	ISSUED FOR APPROVAL	-

DESIGNED J.P. WELMAN SIGNATURE DATE: 12-02-2026	DRAWN E. HOLDER SIGNATURE DATE: 12-02-2026
DESIGN CHECKED BY J.P. WELMAN SIGNATURE DATE: 12-02-2026	INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT SIGNATURE DATE:

PROJECT STATUS

☒ CONCEPT DRAWING	☐ TENDER DRAWING	☐ APPROVED FOR CONSTRUCTION DRAWING	☐ AS BUILT DRAWING
PROJECT ENGINEER (CONSULTANT)			
J.P. WELMAN	20180172	12-02-2026	
INITIALS AND SURNAME			
PROJECT ENGINEER (CITY OF TSHWANE)			
INITIALS AND SURNAME			
STRUCTURAL ENGINEER (CITY OF TSHWANE)			
INITIALS AND SURNAME			
OFFICIAL REPRESENTATIVE (CITY OF TSHWANE)			
INITIALS AND SURNAME			

CONSULTANT DETAIL



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Consulting Civil & Structural Engineers
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Office: +27 12 460 0008
www.civilconcepts.co.za

CITY OF TSHWANE ROADS AND TRANSPORT DEPARTMENT

GROUP HEAD Mr Letlankane P. (Phoko) P.O. BOX 1409 PRETORIA 0001		DIVISIONAL HEAD Mr Thagale M.K.P. (Mavem) P.O. BOX 1409 PRETORIA 0001
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DRAWING APPROVED BY DIVISIONAL HEAD Mr Thagale M.K.P. (Mavem)	
SIGNATURE:	DATE:

LOCATION OF PROJECT: KOSMOSDAL EXT 102
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DESCRIPTION OF PROJECT KOSMOSDAL EXT 102 CULVERT SECTION DETAILS		
WAY/LEAVE NUMBER		
CONTRACT No.: C3530	PROJECT No.: C3530	
DATE: JUNE 2025	SCALE: AS SHOWN	ORIGINAL PAPER SIZE: A1
DRAWING NO: C3530-WUL-001	SHEET NO: 1 OF 1	REVISION 