KUBU PROPERTY INVESTMENTS (Pty) Ltd

BAKUBUNG LEDIG INTEGRATED MIXED USE DEVELOPMENT

FLOODLINE ASSESSMENT REPORT

November 2016

Prepared for:

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KUBU INVESTMENTS (PTY) LTD

BAKUBUNG LEDIG INTEGRATED MIXED USE DEVELOPMENT
CIVIL ENGINEERING SERVICES

FLOODLINE ASSESSMENT REPORT

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KUBU INVESTMENTS (PTY) LTD

BAKUBUNG LEDIG INTEGRATED MIXED USE DEVELOPMENT
CIVIL ENGINEERING SERVICES

FLOODLINE ASSESSMENT REPORT

1 INTRODUCTION

1.1 Background

Bigen Africa has been appointed by Kubu Investments (Pty) Ltd to determine the flood peaks and the associated flood-lines (The 1 in 50 and 1 in 100 year flood-lines) for the proposed Bakubung Ledig Integrated Mixed Use Development. Two defined water course channels in the proposed development area were identified where flood-lines had to be determined. The approximate coordinates of the centre of the site is South 25° 21' 48.19" and East 27° 04' 35.41". (See 1:50 00 topographical map in **Annexure A**)

2 SITE DESCRIPTION

2.1 Locality

The site is located 40km north of Rustenburg in Moses Kotane Local Municipality and it's area is approximately 386 hectares. The area is in portion 15 of the farm Ledig 909JQ which is situated between Ledig and Sun City in the North-West Province. The area is bordered to the south by the R556 provincial road and to the west by R565 and the Pilanesberg Nature Reserve to the North. (See locality plan in **Annexure B**).

2.2 Catchment Area

The area falls within the Crocodile-Marico River catchment and within the quaternary catchment A22F. The Elands River occurs to the south of the site. The rivers and wetlands on the proposed development site are semi-ephemeral streams. The main river bisecting the site originates within the Pilanesberg National Park and ultimately joins the Elands river system which flows east and joins the Crocodile River. The Pilanesberg is an old volcanic crater and as such, provides a highland mountainous source, from wetlands, springs and is supplemented by rainfall.

The total catchment for Area1 is 5.035 km² for the well-defined water course and the catchment for Area2 is 1.105 km² for the poorly defined water course. (See catchment areas in **Annexure C**).

2.3 Topography

The topography of the catchment area ground falls from north to south, with an elevation of 1420m above sea level on the ridge immediately north of the site to 1063m above sea level in the south western sector and 1057m above sea level in the south east. The area is characterised by a combination of flat plains and isolated koppies and mountainous areas to the north of the development site, it is also impacted and appears to have been cultivated in the past.

The proposed development area falls within the summer rainfall climatic zone with dry winters. An average mean annual precipitation (MAP) of 675mm was taken between Weather Service Station No. 0511400W (Rustenburg POL) and 0511/523 4 (Rustenburg AGR) as they are the stations nearer to the proposed development.

The area is bisected by the main river that originates within the Pilanesberg National Park. The site falls to the south with a well-defined water course running from the north to the south centrally through the development area and a second poorly defined water course running from the North West to South East of the site that ultimately joins the Elands River system which flows east and joins the Crocodile River.

Calculated Run-off Co-efficient of 0.4 was determined from the topographic characteristics summarised on the table below:

Topographic Characteristics

Characteristic	AREA1	AREA2
Catchment Area (km²)	5.035	1.105
Highest point in Catchment (masl)	1420	1350
Longest water course (km)	4.75	2.028
Annual average rainfall (mm)	675	675
Maximum Height difference, Hmax (m)	227	193
Average Slope, Sav (m/m)	0.06372	0.12681

3 FLOOD DETERMINATION

3.1 Methodology/Strategy

The peak runoff calculations were carried out using the data indicated in the topographic characteristics table above and rational method of computation. This method was used in calculating the run-off discharge for the two defined water course storm-water catchment areas. The HEC-RAS (Hydrologic Engineering Centre's River Analysis System Version 4.1.0) computer analysis software was used for modelling the channel flow.

The final proposed flood peaks employed in the calculations were summarised and the details of the Hydrological analysis was obtained using the software of Utility Programs for Drainage developed by Sinotech cc the results are attached in **Annexure D**.

3.2 Floodline Modelling

The 1:50 and 1:100 flood-lines were determined using the HEC-RAS (Hydrologic Engineering Centre's River Analysis System Version 4.1.0) computer analysis software as mentioned above.
A digital terrain model (DTM) was generated from the tacheometric survey of the defined water course, using AutoCAD Civil 3D. The DTM was used to produce a longitudinal section of the two streams. Cross-sections of the two defined water course were generated along the centre of the channels and at the culverts crossing the R556, this crossings were the critical points.

3.3 Flood Profile Computation

The longitudinal section and cross-sections were imported into the HEC-RAS model and used as inputs in the flood-line simulation. The simulation of the flood was based on Manning's formula using an n-value (roughness coefficient) of 0.045 and 0.06. The computation of the flood scenario was based on "steady flow" condition.

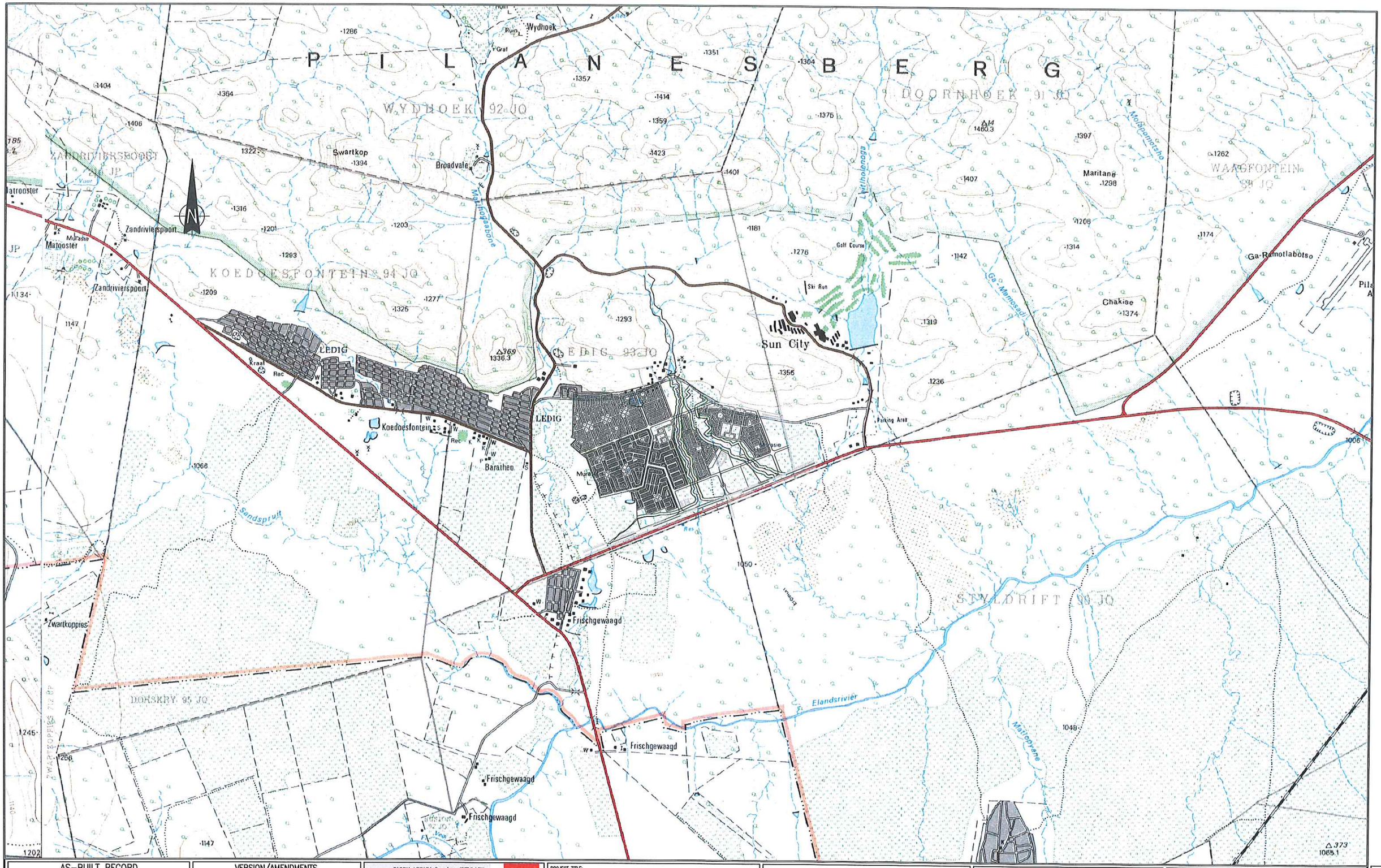
Cross-sections were extracted for two defined water courses at 50m interval along the centre line of the channel and at critical points. This was done using the available contour data from the digital terrain model. Circular Culverts crossing R556 were considered in the models, Inverts levels and other data were extracted from the survey and site investigations and these were used as input into the model. Schematic map of 1:50 and 1:100 flood-line profiles is shown with 1m contours in **Annexure E**.
All HEC-RAS OUTPUT data and cross sections are attached in **Annexure F**.

3.4 The Flood-line assessment indicated the following:

- Increasing the capacity of the storm water infrastructure crossing under R556.

ANNEXURE A

1:50 000 Topographical Map



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PROJECT TITLE:

BAKUBUNG LEDIG
MIXED-USE DEVELOPMENT

DRAWING TITLE:

1:50 000 PLAN

0 50 100
100mm ON ORIGINAL DRAWING

ORIGINAL DRAWING SCALE:	NTS	ORIGINAL DRAWING SHEET SIZE:	A1

APPROVED:

CLIENT OR ASSIGNEE: DATE:

CLIENT DRAWING No.:	CLIENT REF No.:

SURVEYED	-	DESIGNED	-
DRAWN	G. Bezuidenhout	CHECKED	D. Storbeck
CO-ORDINATE SYSTEM:	WG29	DATE:	August 2016

APPROVED ON BEHALF OF BIGEN AFRICA:

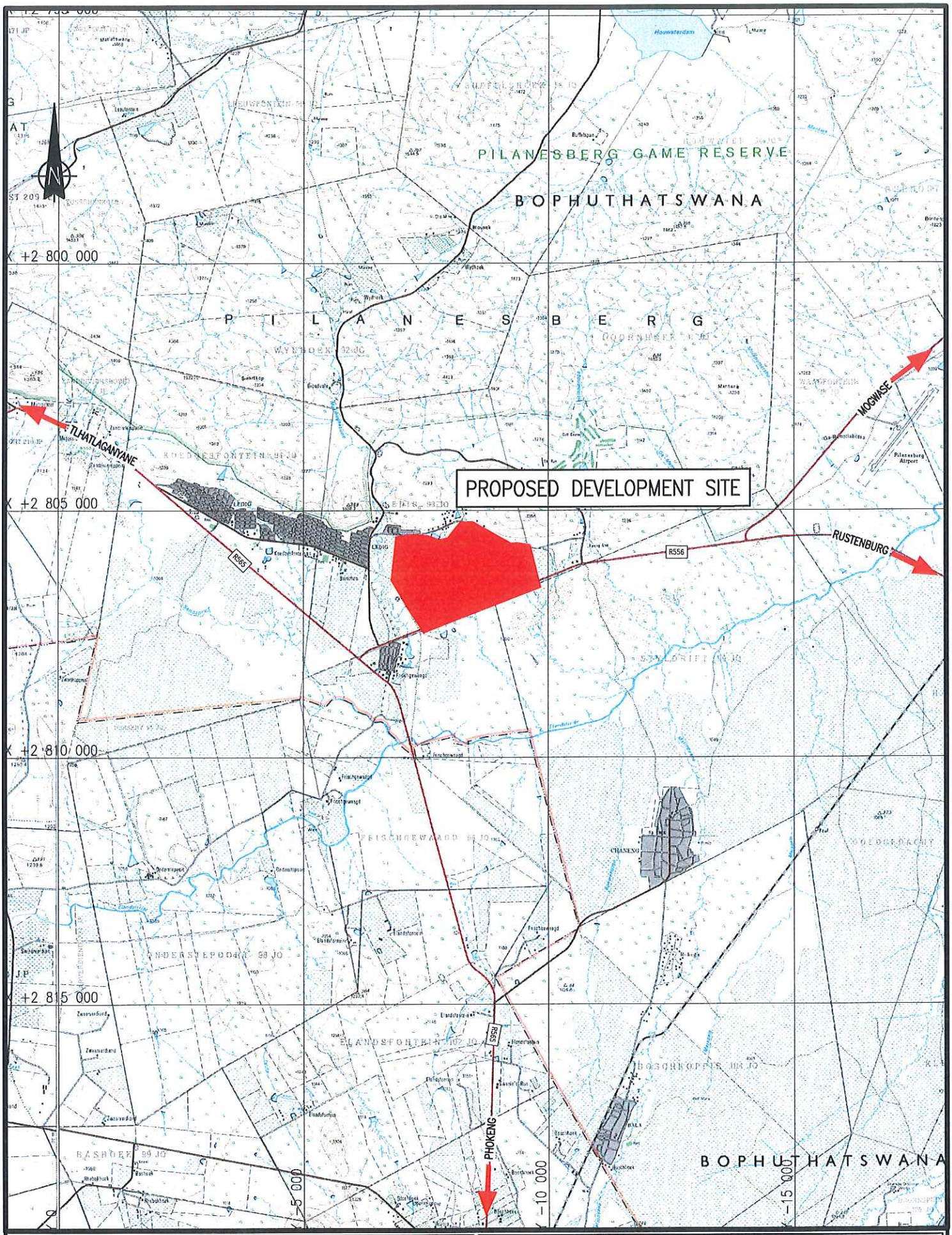
ENGINEER: DATE:

DRAWING No.:	VERSION:
2734.20.ZA.04.A003	A.0

2734.20.ZA.04.A003

ANNEXURE B

Locality Plan



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BIGEN AFRICA

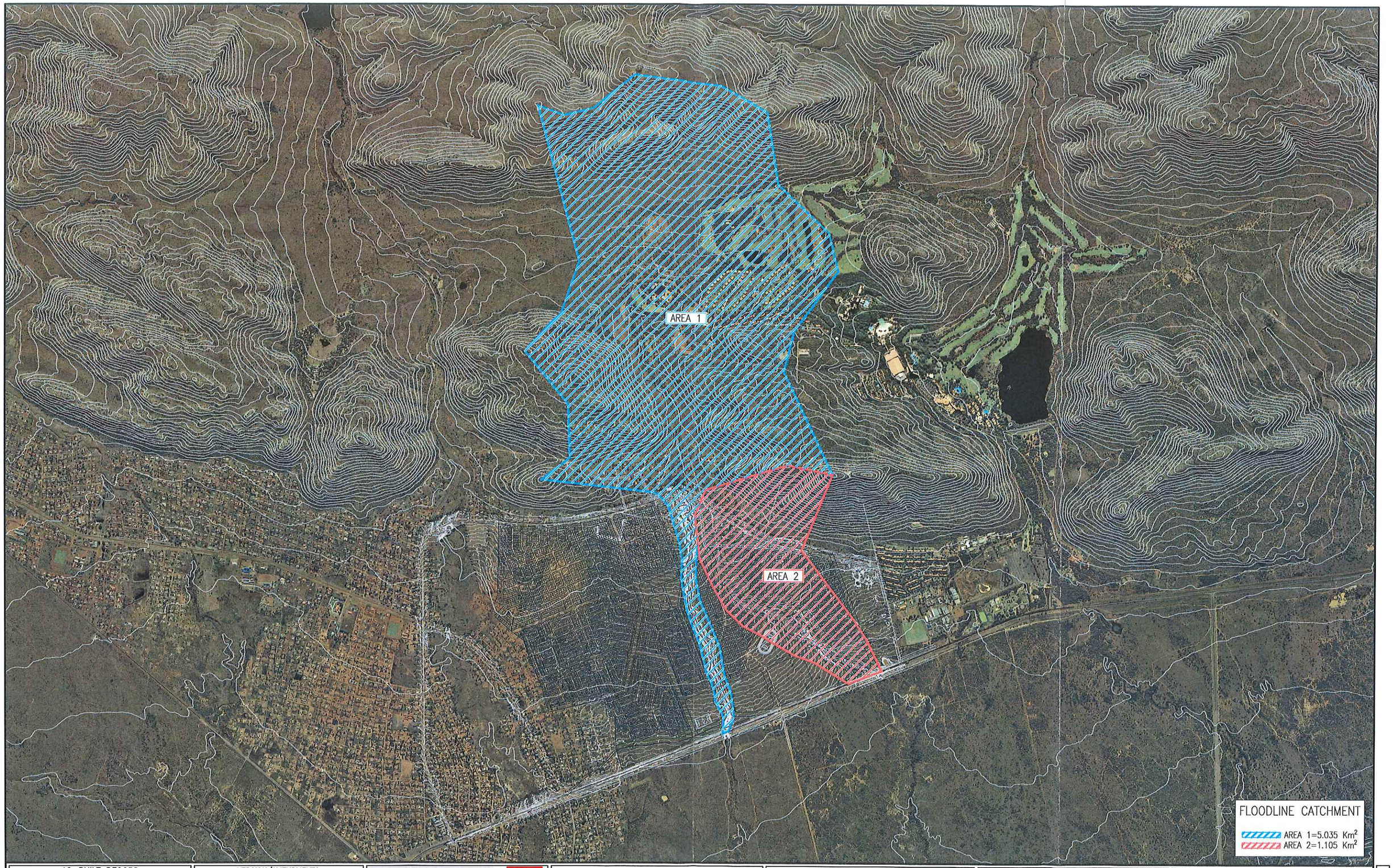
PROJECT: BAKUBUNG INTEGRATED MIXED USE DEVELOPMENT

DWG TITLE: LOCALITY PLAN

DRAWN:	CHECKED:	APPROVED:	SCALE:	DATE:	DWG No:	VER:
L. Pitse	D.O. Storbeck	D.O. Storbeck	N.T.S	September 2015	2734.00.ZA.01.S001	A.0

ANNEXURE C

Catchment Area



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PROJECT TITLE:
BAKUBUNG LEDIG
MIXED-USE DEVELOPMENT

DRAWING TITLE:
FLOODLINE CATCHMENT AREA

0 50 100
100mm ON ORIGINAL DRAWING

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CLIENT DRAWING No.: CLIENT REF No.:

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ENGINEER: DATE:

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VERSION: A.0

2734.20.ZA.04.A001

ANNEXURE D

Hydrological Analysis

Utility Programs for Drainage
Flood calculations

Sinotech

Project name: Bakubung Floodline
Analysed by: Regina Sithole
Name of river: Bakubung
Description of site: Area1 Floodline
Filename: C:\Users\maphrm\Desktop\Projects 2015\Bakabung\Bakubung Area1 Floodline.fld
Date: 13 January 2016

Flood Frequency Analysis: Rational Method

Project	= Bakubung Floodline
Analysed by	= Regina Sithole
Name of river	= Bakubung
Description of site	= Area1 Floodline
Date	= 2016-01-13
Area of catchment	= 5.035 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 675.00 mm
Length of longest watercourse	= 4.75 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 227.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

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

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	4	Very permeable	0	Thick bush & forests	5
Flat area	0	Permeable	50	Light bush & cultivated land	65
Hilly	96	Semi-permeable	50	Grasslands	30
Steep areas	0	Impermeable	0	Bare	0

Average slope	= 0.06372 m/m
Time of concentration	= 38.1 min
Run-off factor	
Rural - C1	= 0.411
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.411

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)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:10	0.64	47.8	99.0	74.4	0.85	35.0	36.37
1:50	0.64	76.6	98.4	118.6	0.95	39.1	64.83
1:100	0.64	94.3	98.0	145.4	1.00	41.1	83.66

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

Calculated using Utility Programs for Drainage 1.0.2

Utility Programs for Drainage
Flood calculations

Project name: Bakubung A2 Floodline
Analysed by: Regina Sithole
Name of river: Bakabung
Description of site: Area2 Floodline
Filename: C:\Users\maphrm\Desktop\Projects 2015\Bakabung\Bakubung Area2 Floodline.fld
Date: 13 January 2016

Flood Frequency Analysis: Rational Method

Project	= Bakubung A2 Floodline
Analysed by	= Regina Sithole
Name of river	= Bakabung
Description of site	= Area2 Floodline
Date	= 2016-01-13
Area of catchment	= 1.105 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 675.00 mm
Length of longest watercourse	= 2.028 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 192.871 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

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

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	5
Flat area	80	Permeable	50	Light bush & cultivated land	65
Hilly	0	Semi-permeable	50	Grasslands	30
Steep areas	20	Impermeable	0	Bare	0

Average slope	= 0.12681 m/m
Time of concentration	= 15.2 min
Run-off factor	
Rural - C1	= 0.373
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.373

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

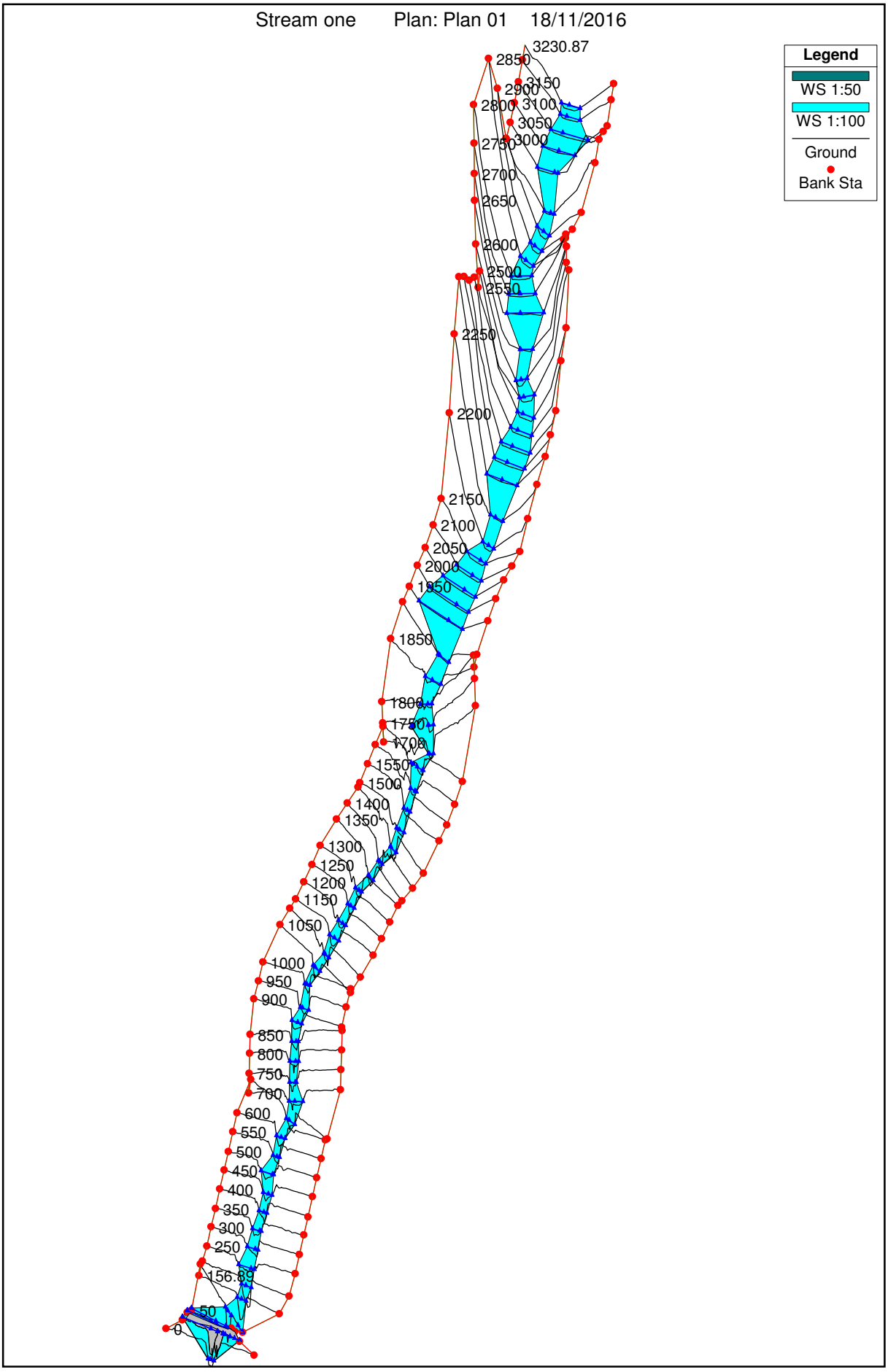
Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:10	0.25	31.6	99.6	124.3	0.85	31.7	12.08
1:50	0.25	50.7	99.4	199.0	0.95	35.4	21.62
1:100	0.25	62.4	99.3	244.6	1.00	37.3	27.97

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

Calculated using Utility Programs for Drainage 1.0.2

ANNEXURE E

HEC-RAS Output Data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Legend
WS 1:50
WS 1:100
Ground
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2850
3150
2900
2800
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3000
2700
2650
2600
2500
2550
2250
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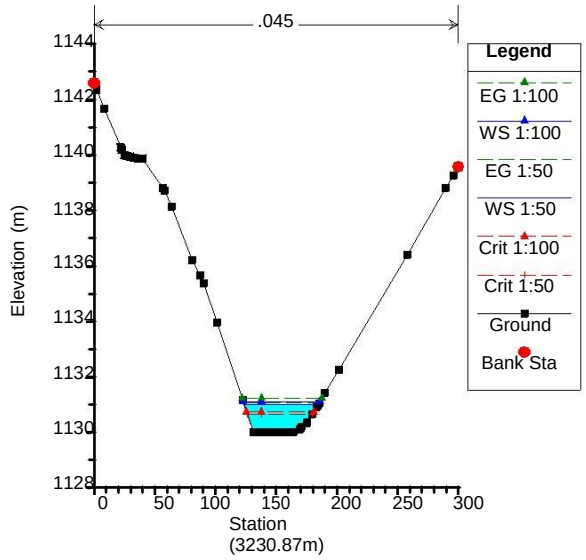

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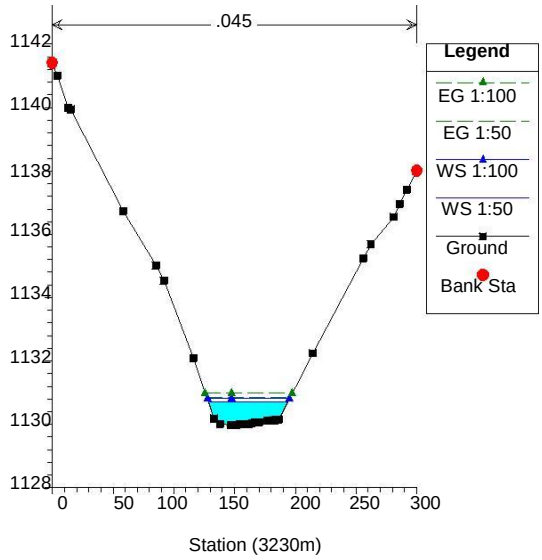

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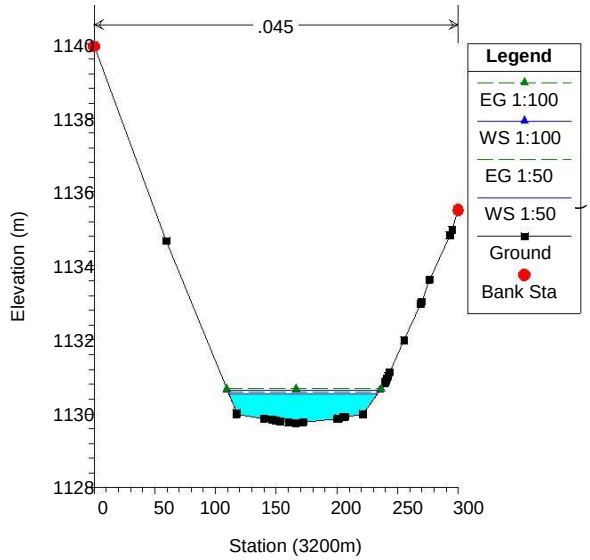

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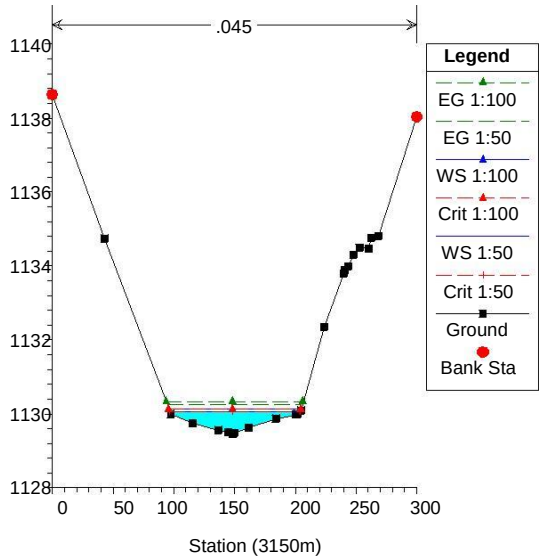

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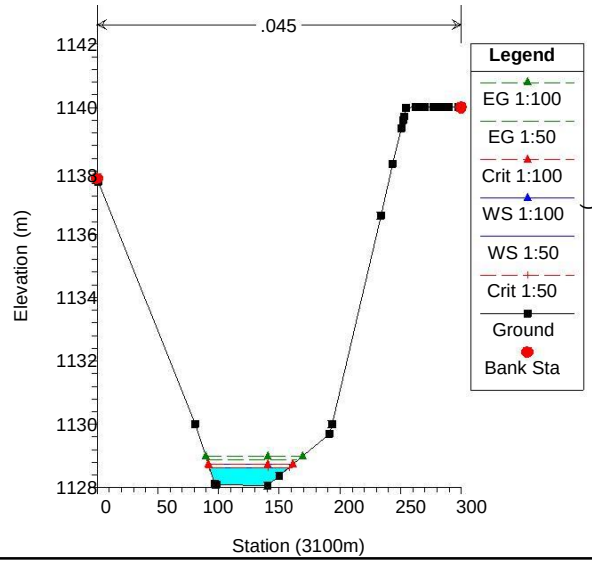

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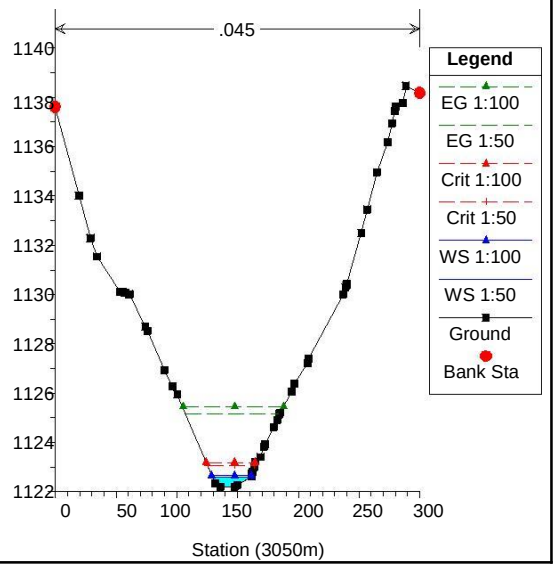

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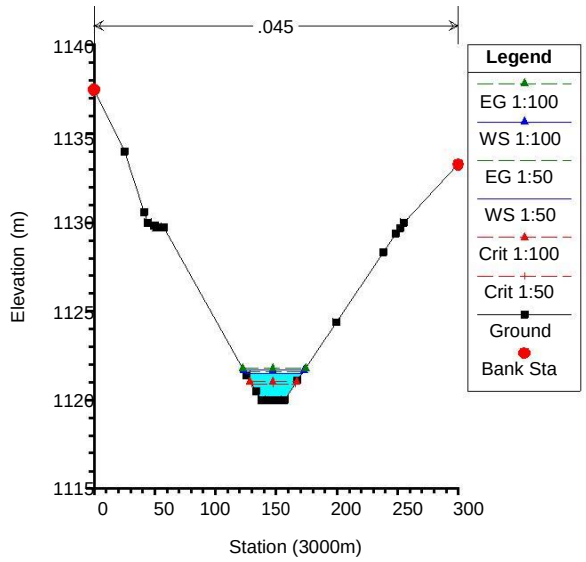

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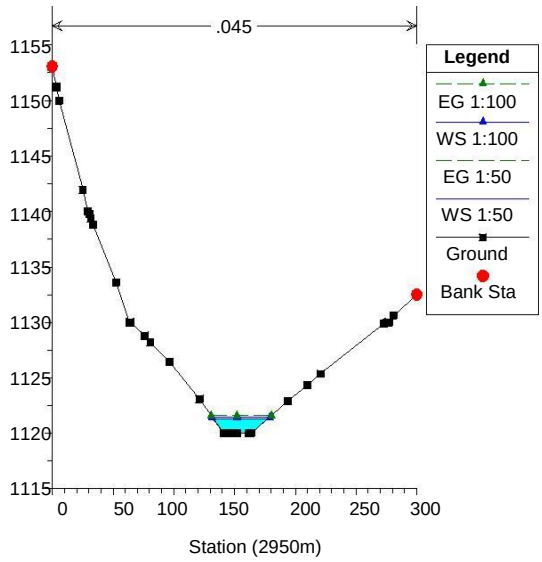

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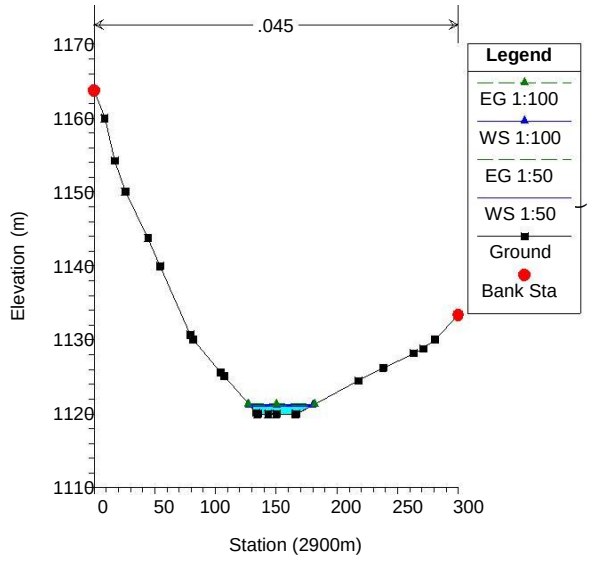

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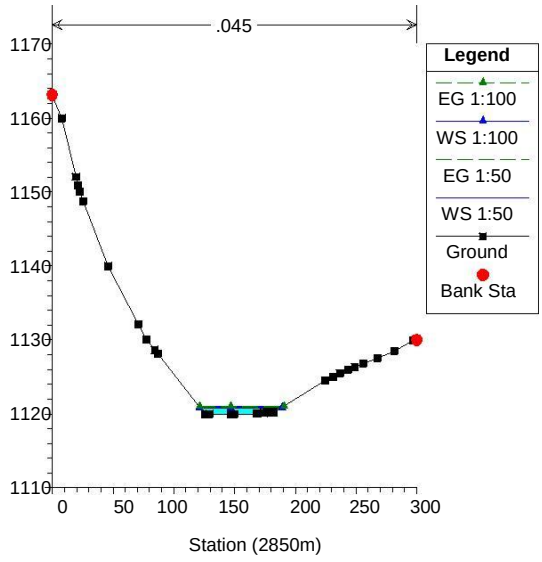

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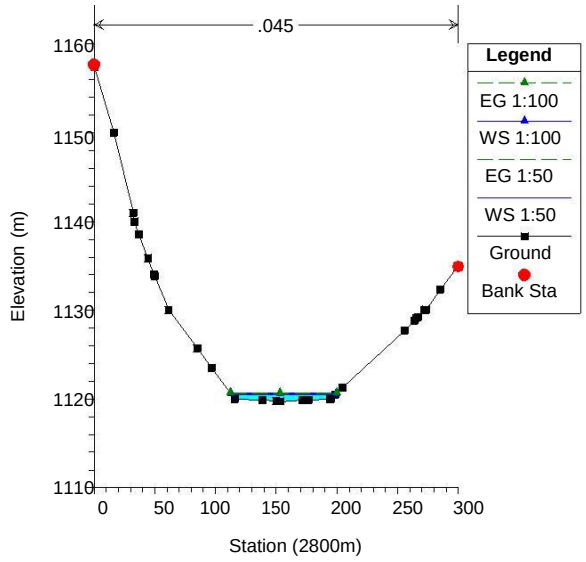

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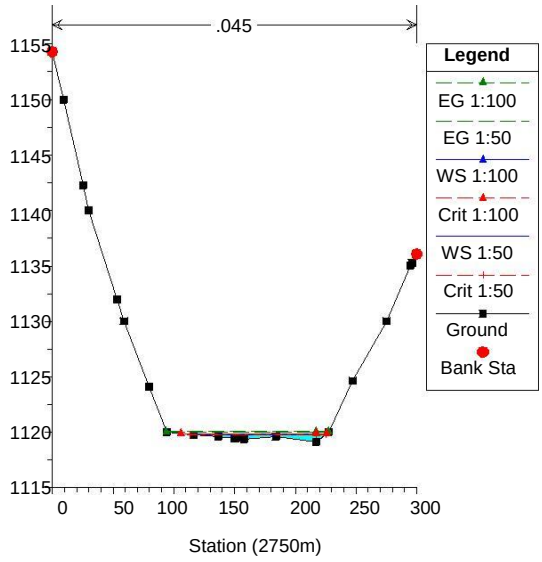

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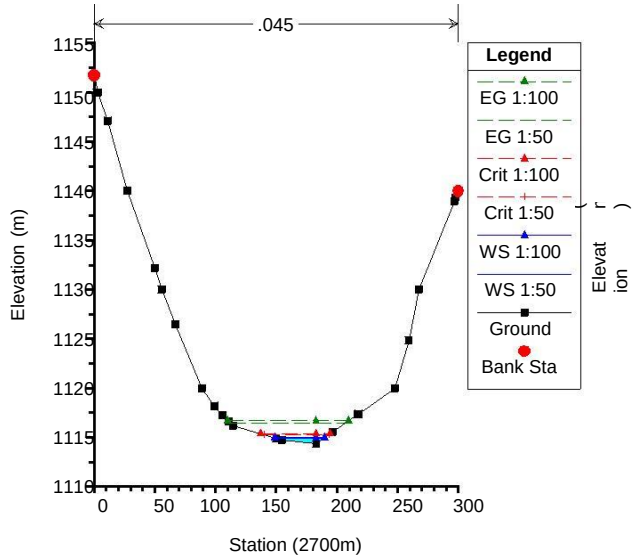

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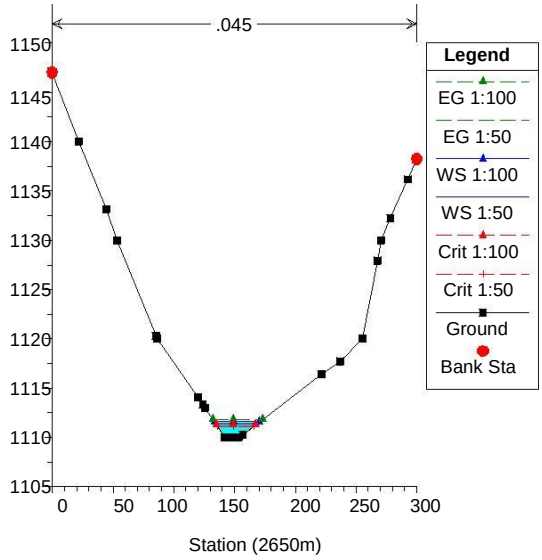

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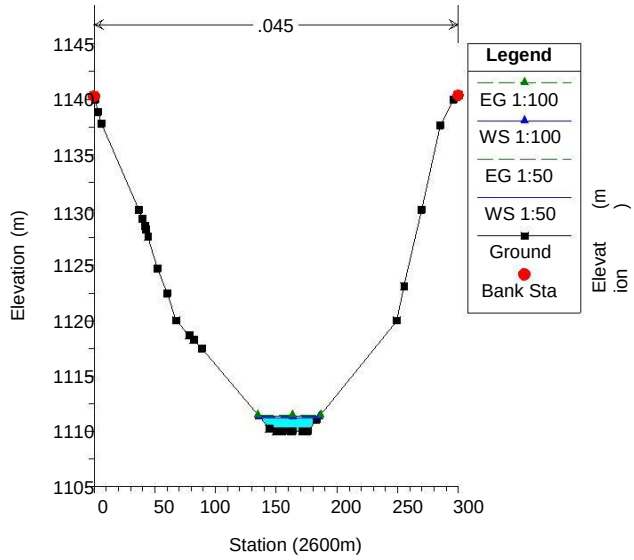

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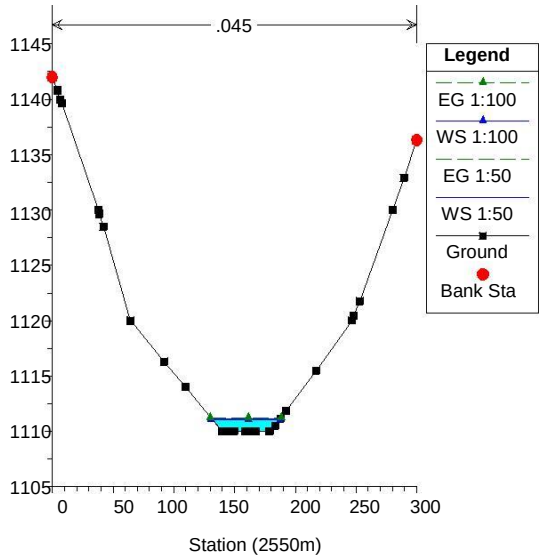

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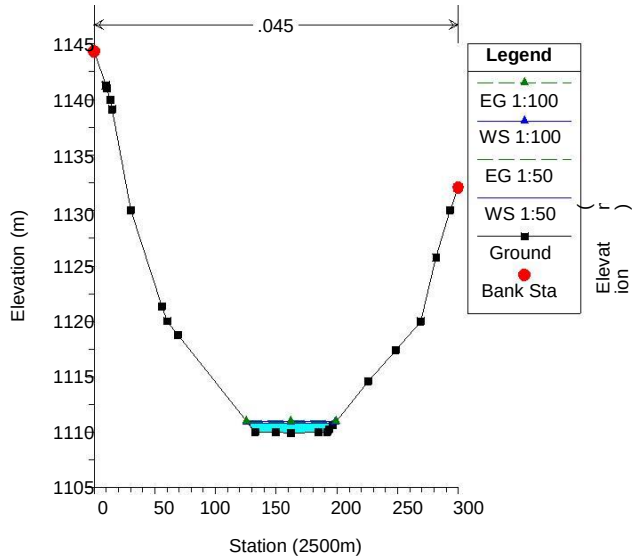

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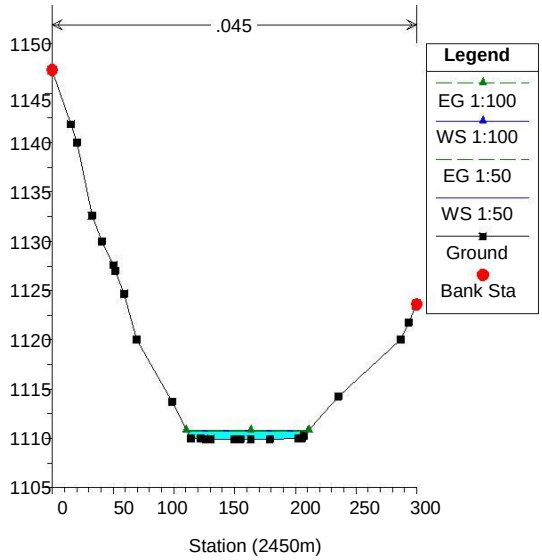

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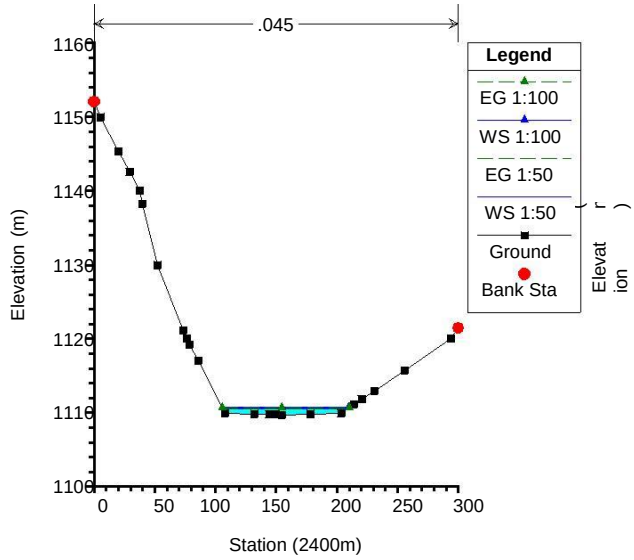

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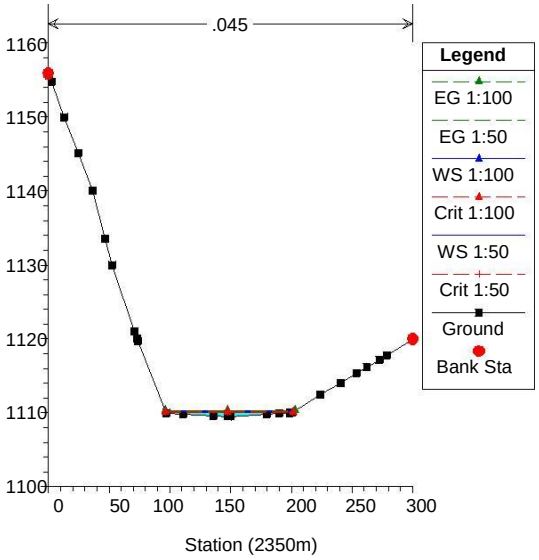

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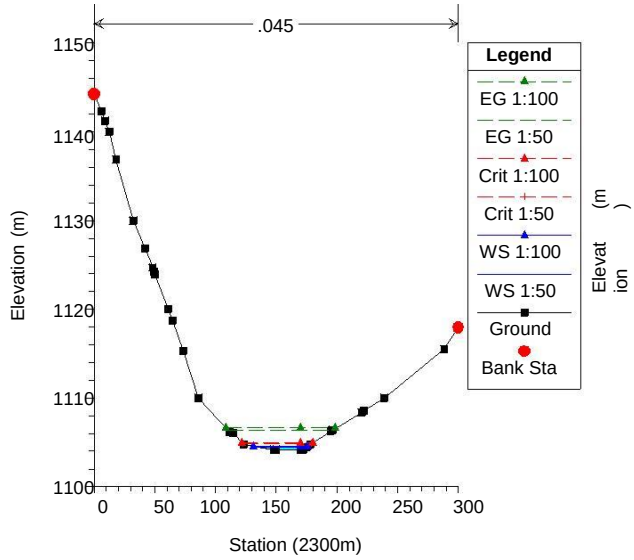

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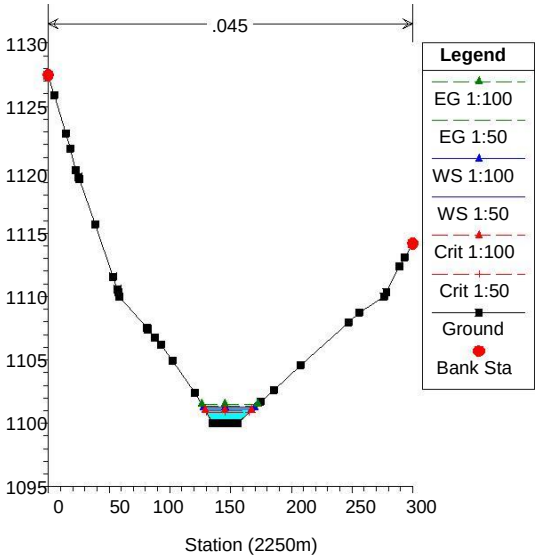

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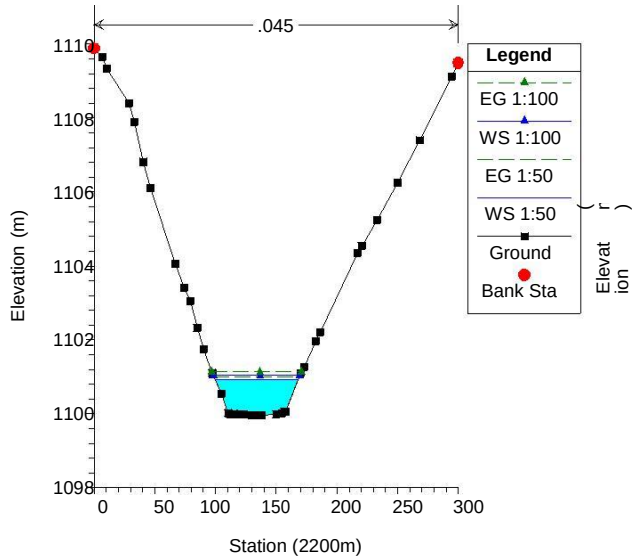

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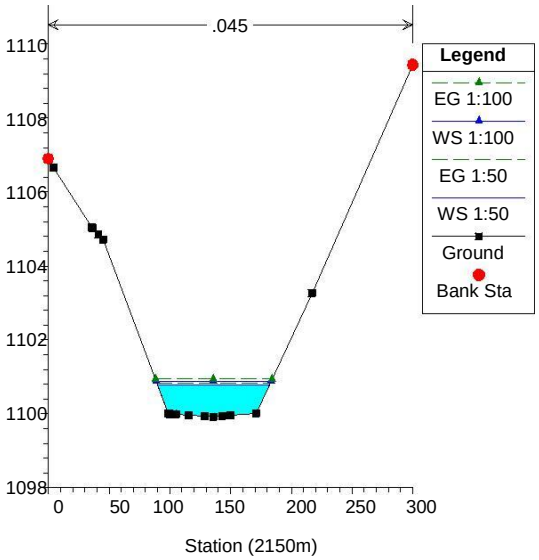

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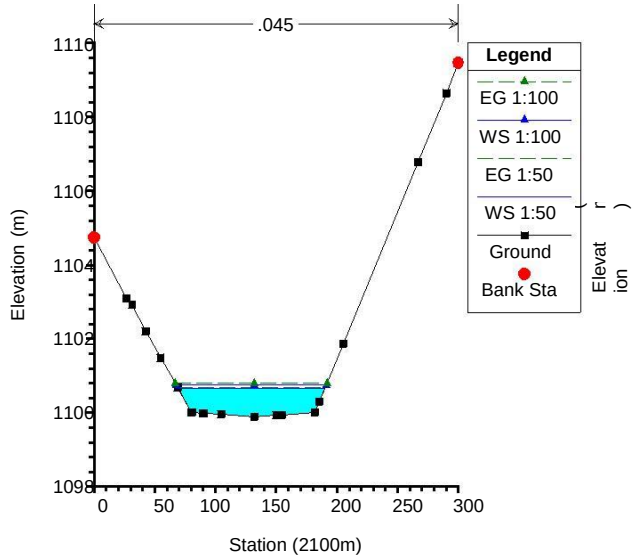

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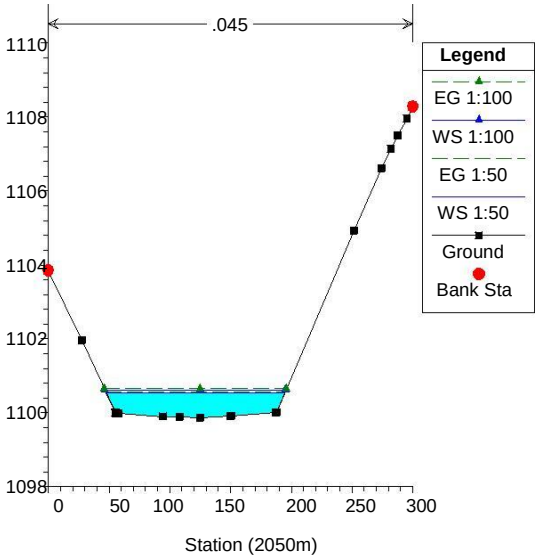

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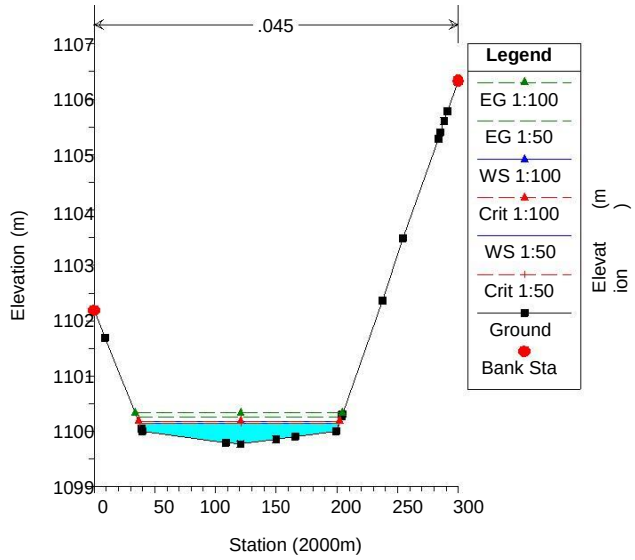

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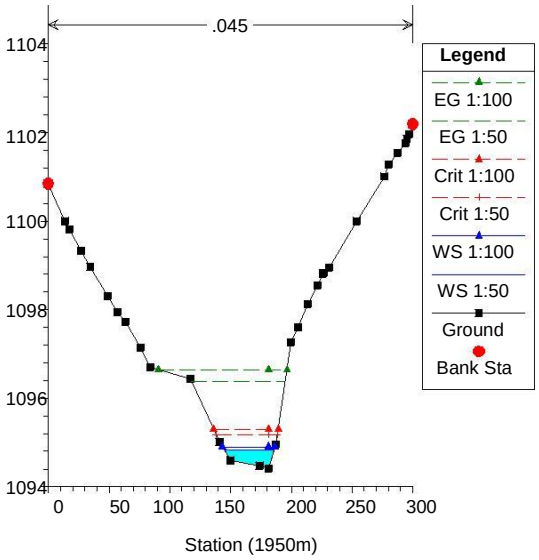

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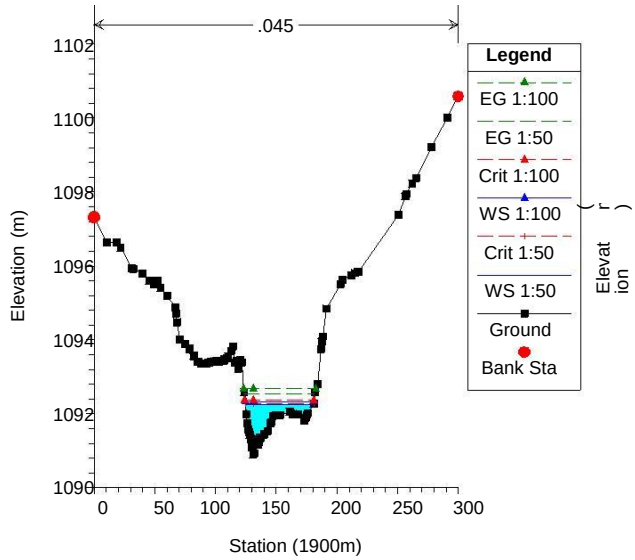
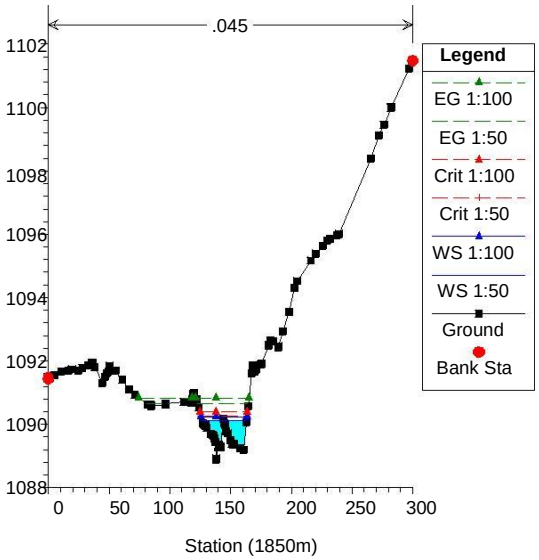
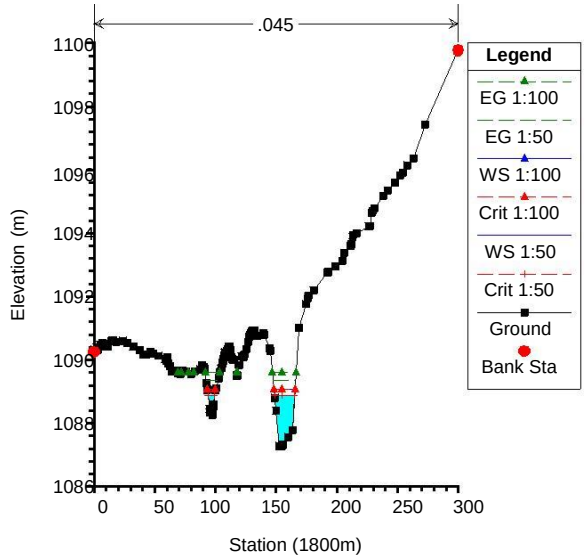


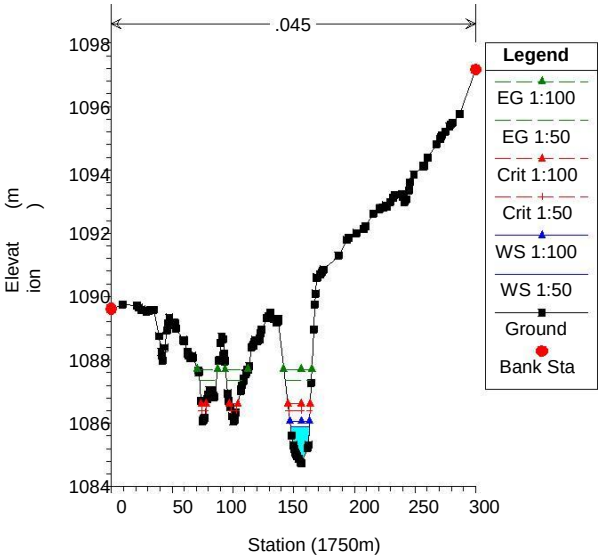
Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



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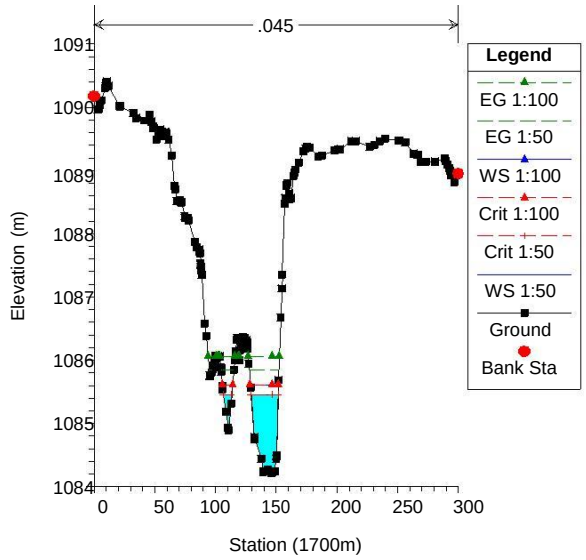
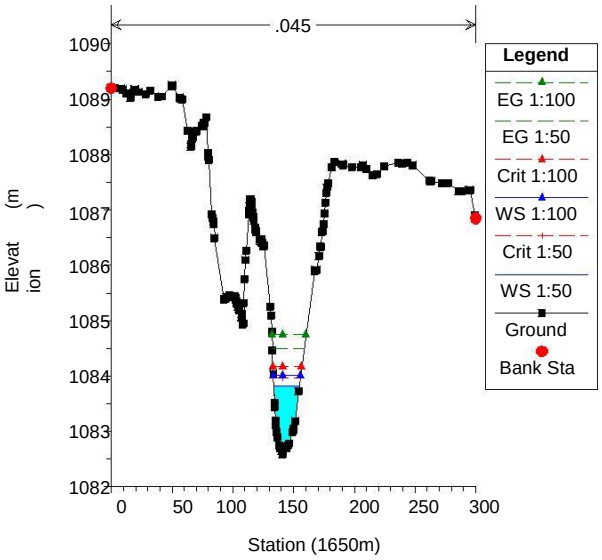
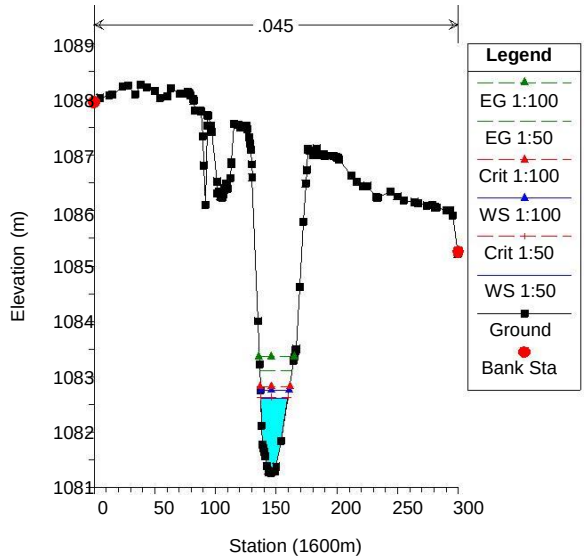


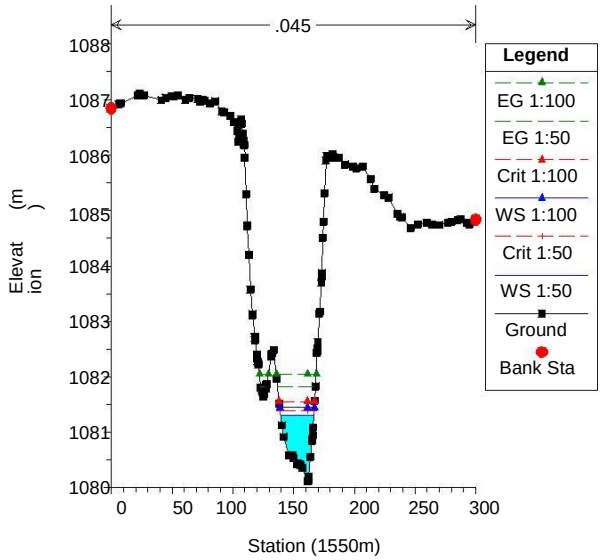
Stream one Plan: Plan 01 18/11/2016



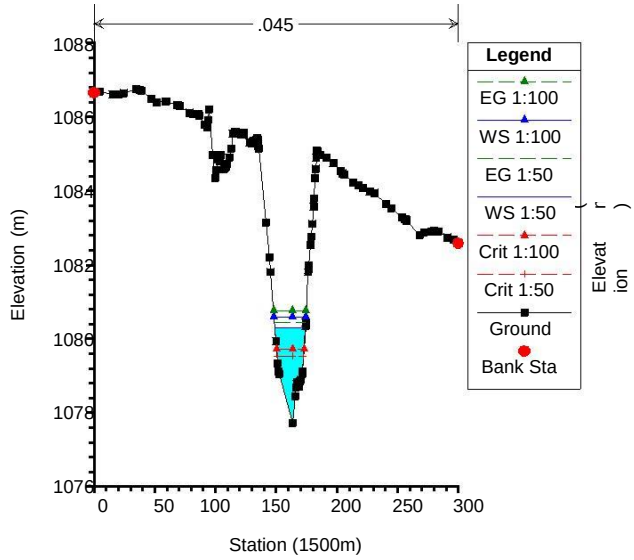
Stream one Plan: Plan 01 18/11/2016



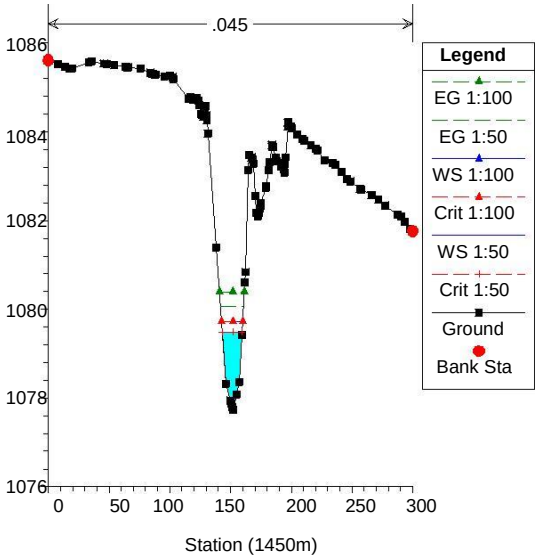
Stream one Plan: Plan 01 18/11/2016



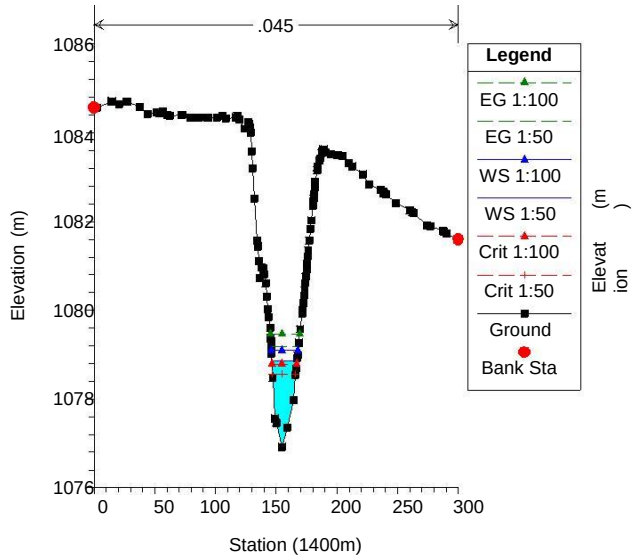
Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



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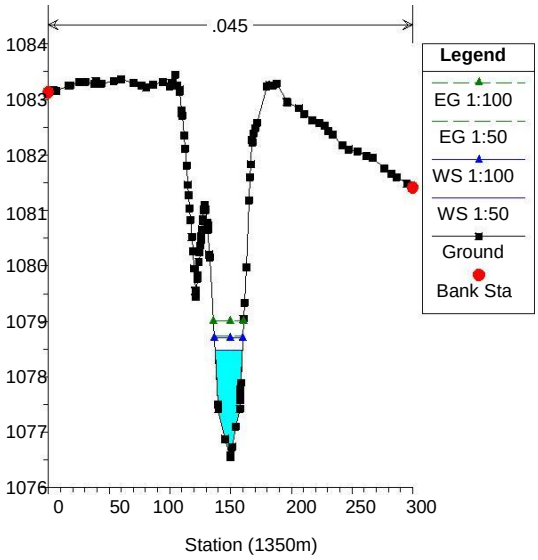

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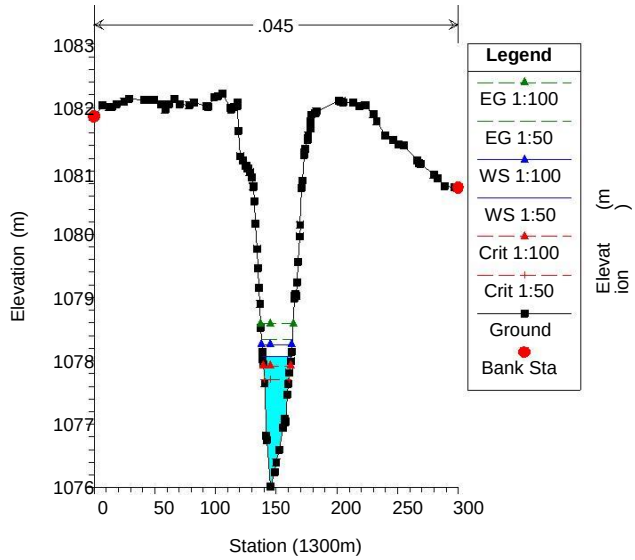

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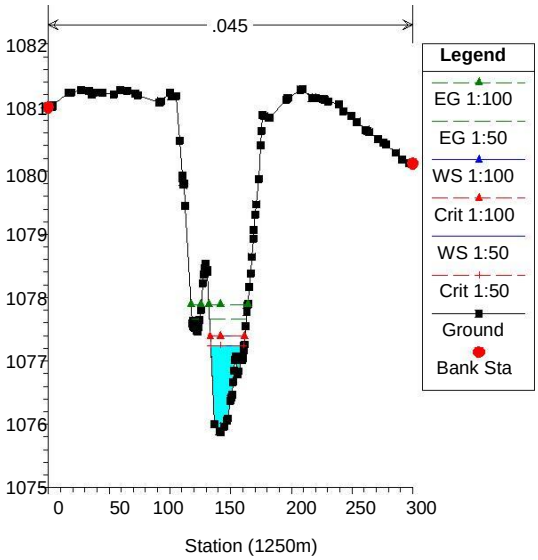

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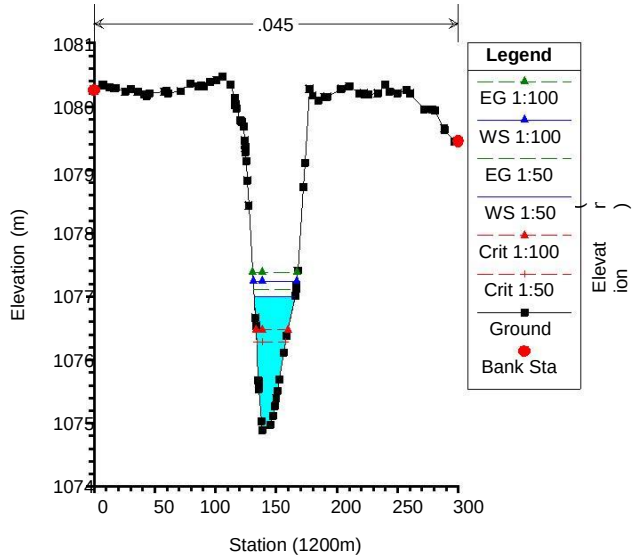

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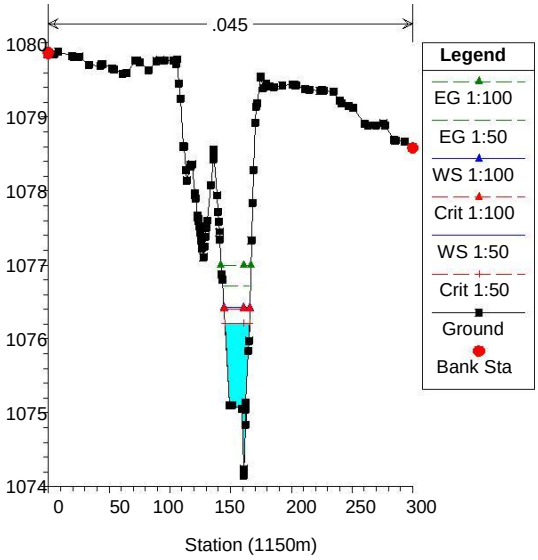
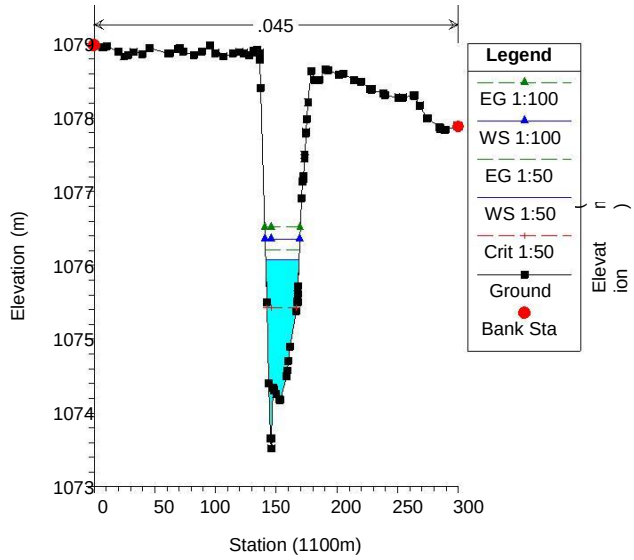
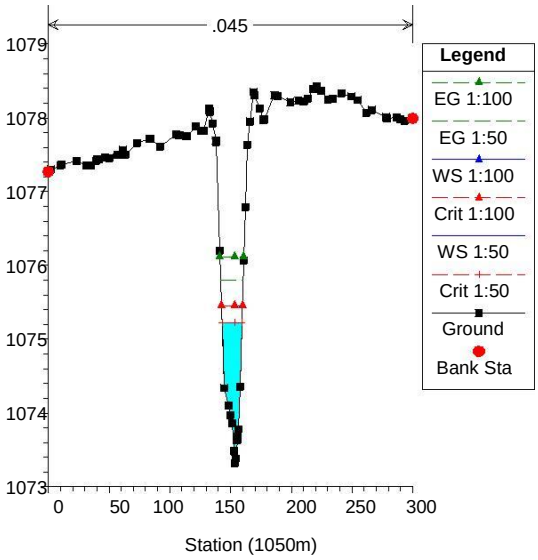


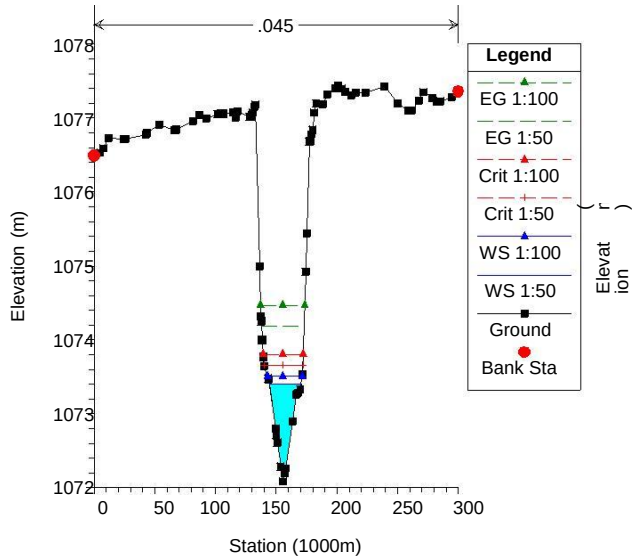
Stream one Plan: Plan 01 18/11/2016



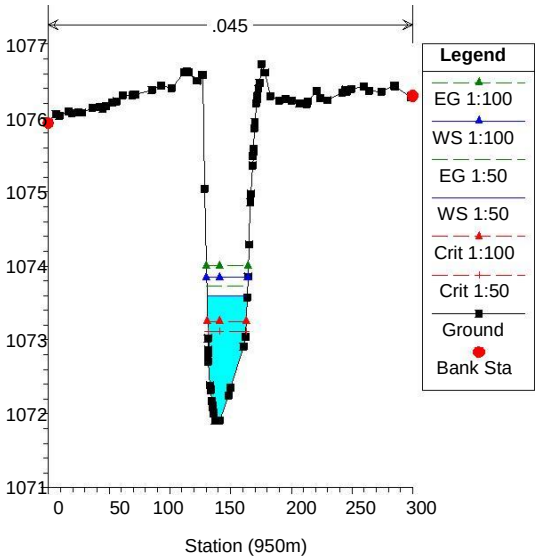
Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



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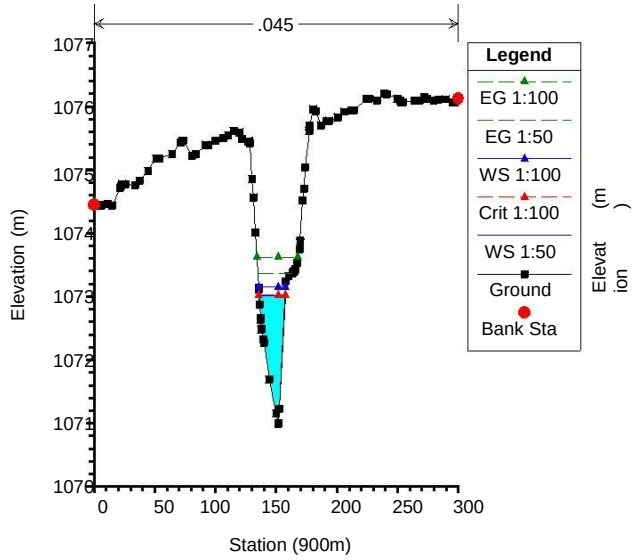
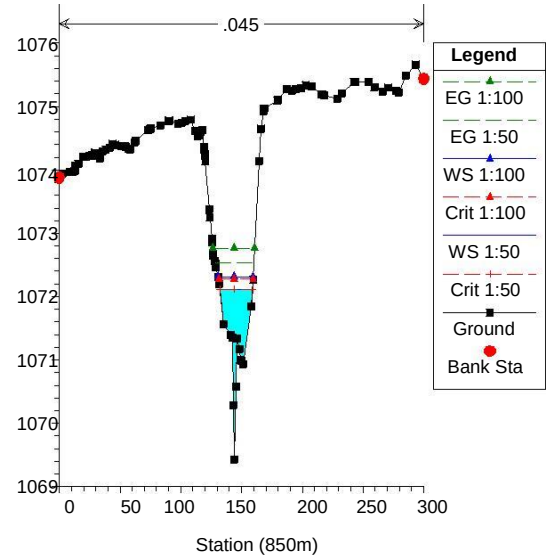
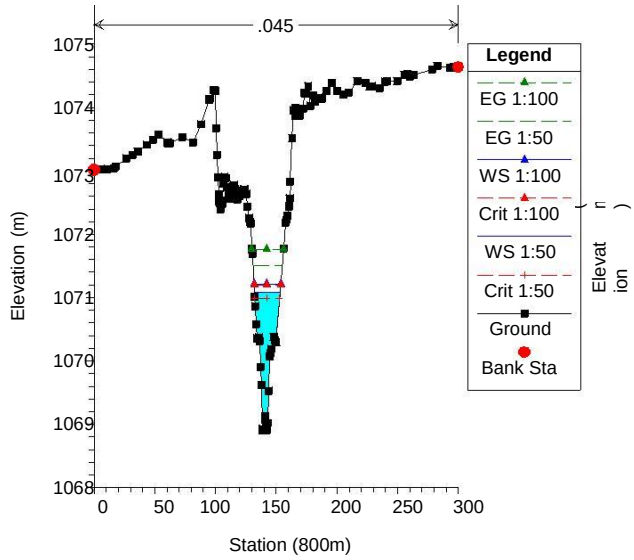


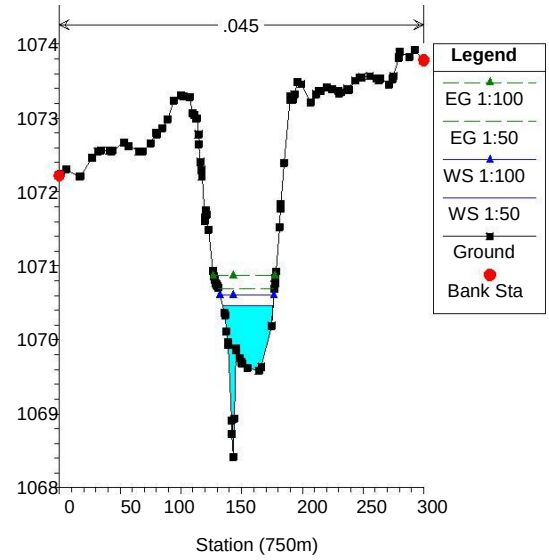
Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



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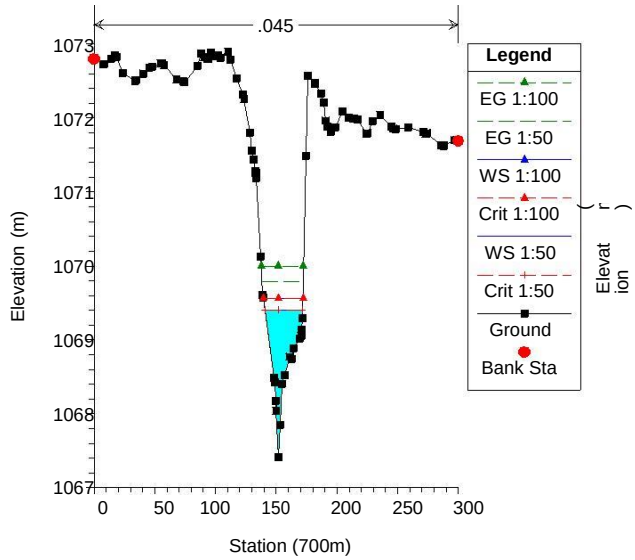

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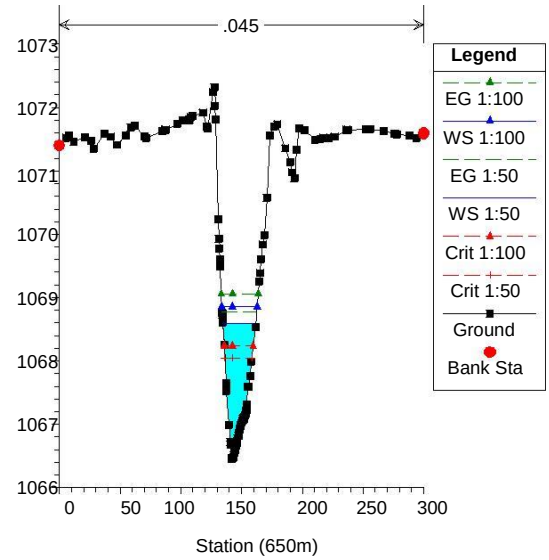

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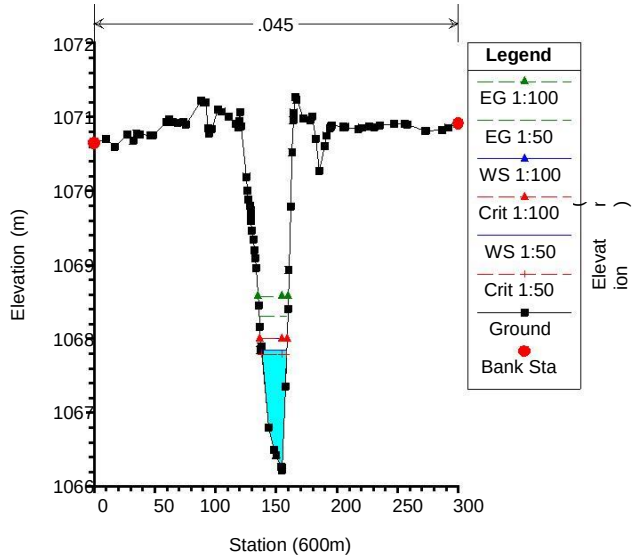

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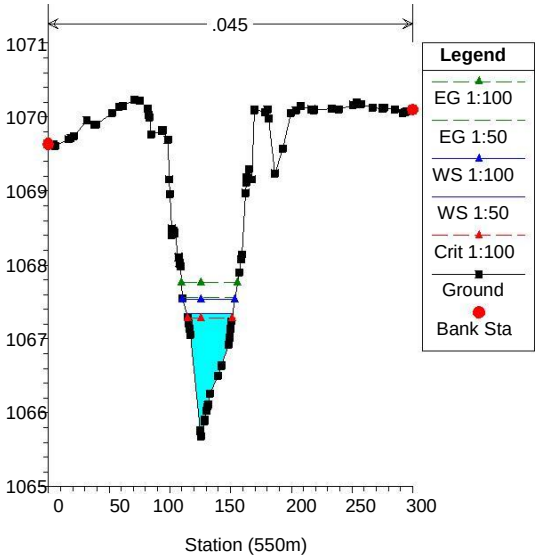

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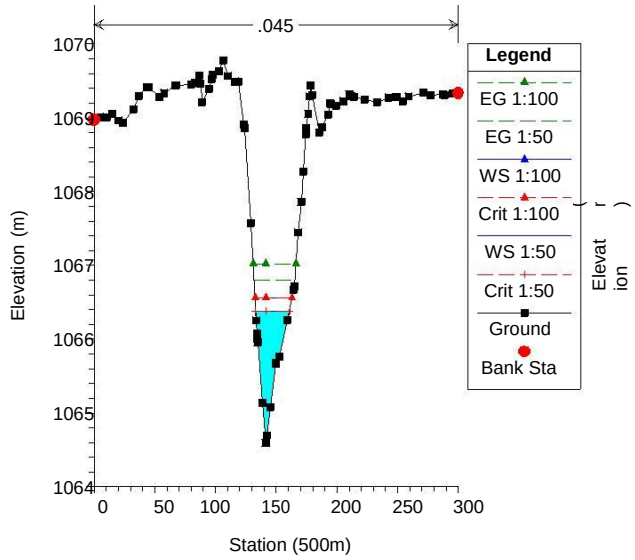
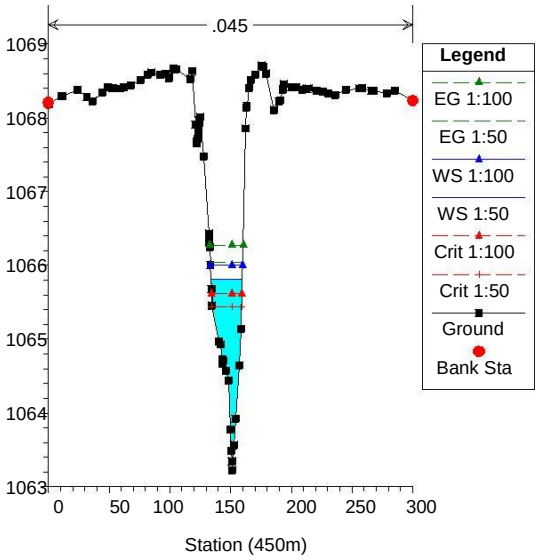
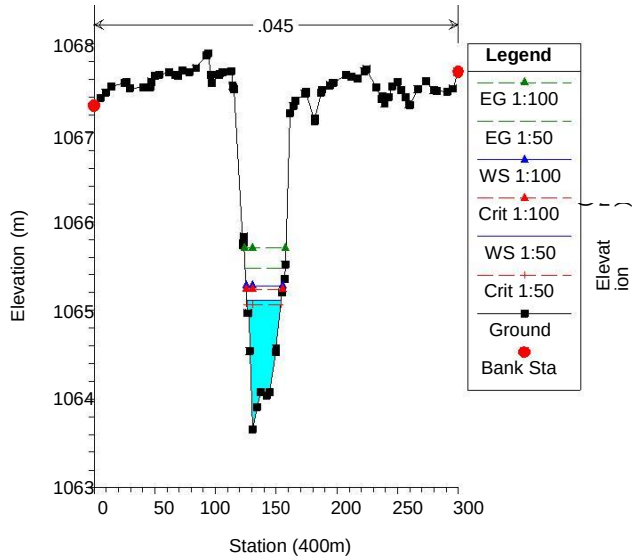


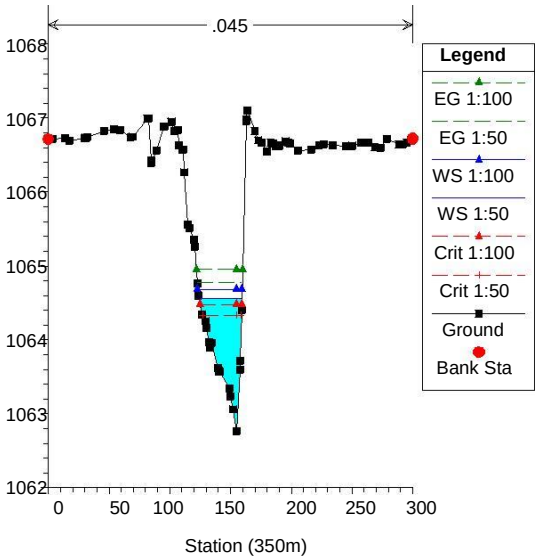
Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



Stream one Plan: Plan 01 18/11/2016



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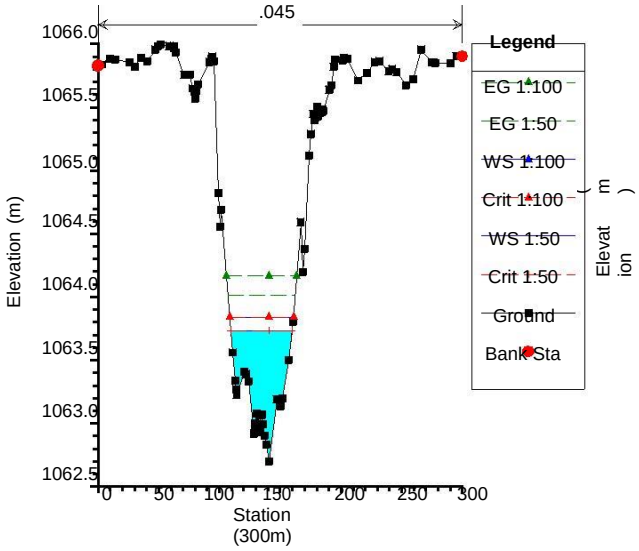
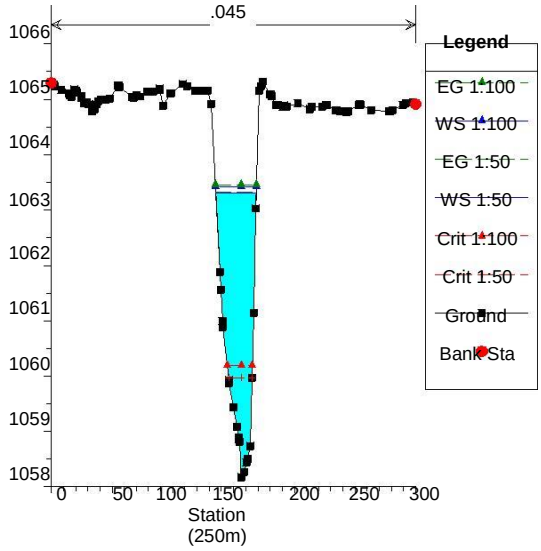


Stream one Plan: Plan 01 18/11/2016



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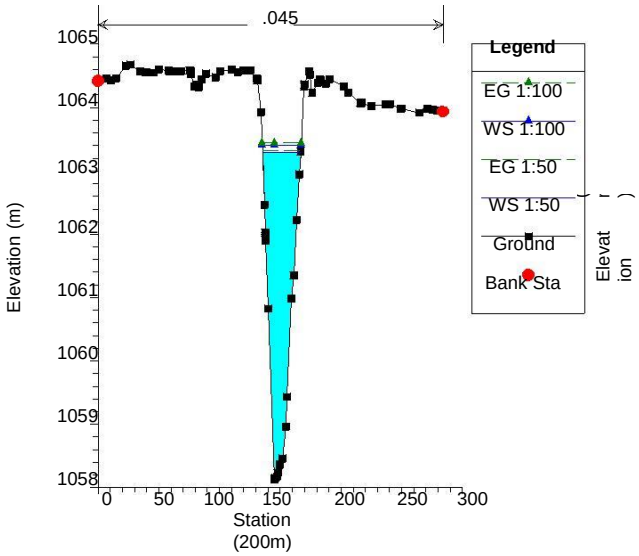

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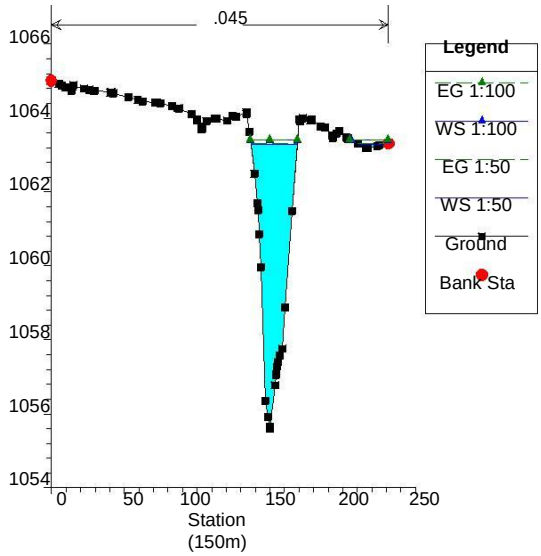

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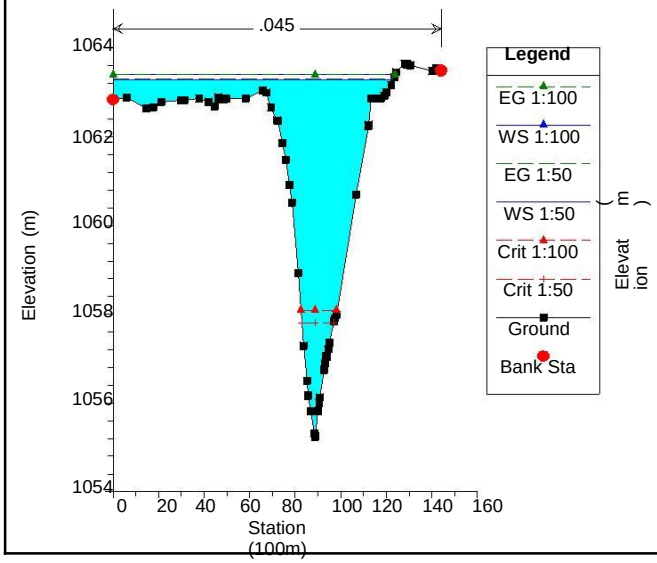
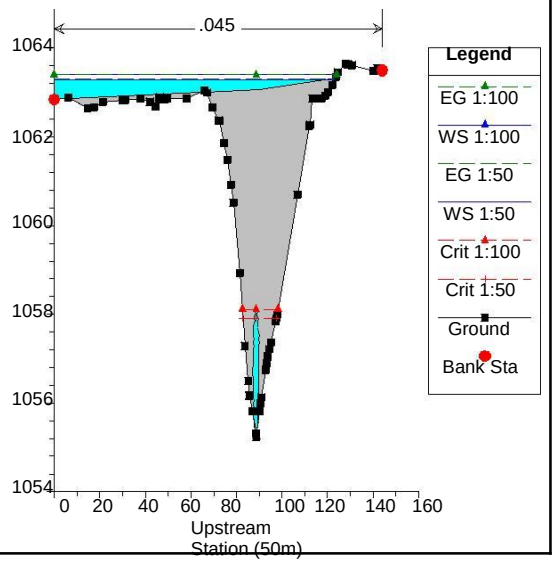
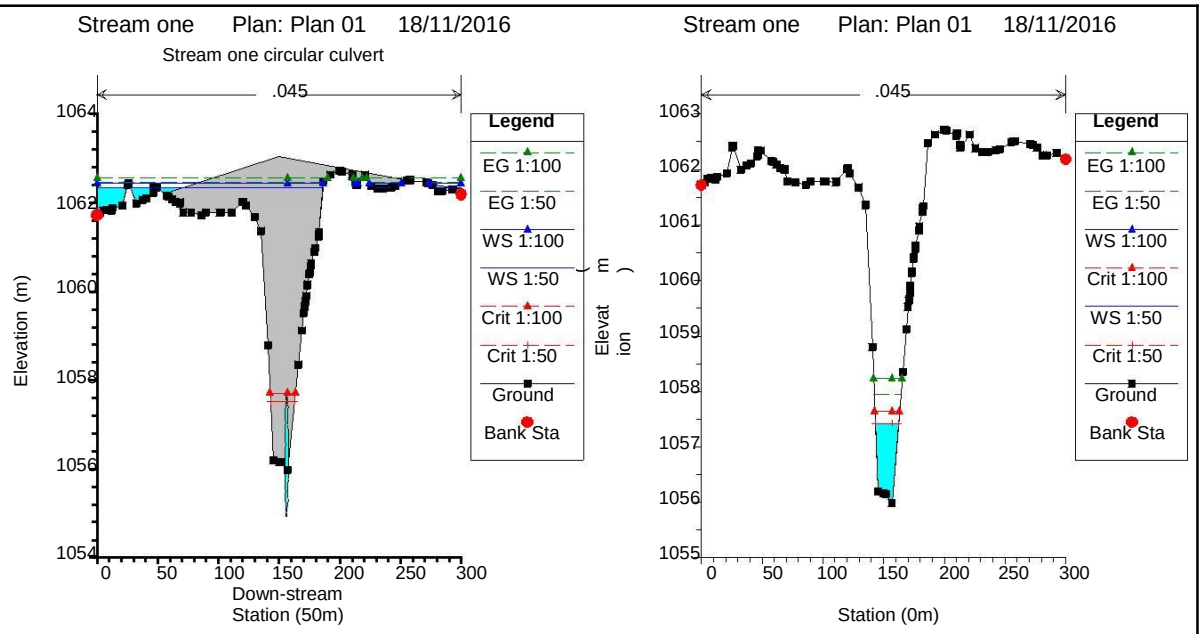


Stream one Plan: Plan 01 18/11/2016

Stream one circular culvert




Stream one Plan: Plan 01 18/11/2016
Stream one circular culvert
.045
Legend
EG 1:100
EG 1:50
WS 1:100
WS 1:50
Crit 1:100
Crit 1:50
Ground
Bank Sta
Elevation (m)
Down-stream
Station (50m)
Stream one Plan: Plan 01 18/11/2016
.045
Legend
EG 1:100
EG 1:50
WS 1:100
Crit 1:100
WS 1:50
Crit 1:50
Ground
Bank Sta
Elevation (m)
Station (0m)

HEC-RAS Plan: Plan 01 River: Stream one Reach: Area1 Alignment

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)	
Area1 Alignment	3230.87	1:50	64.83	1129.99	1130.99	1130.63	1131.08	0.004952	1.34	48.40	60.97	0.48
Area1 Alignment	3230.87	1:100	83.66	1129.99	1131.11	1130.74	1131.22	0.005359	1.49	56.00	63.54	0.51
Area1 Alignment	3200	1:50	64.83	1129.97	1130.72		1130.86	0.011064	1.66	39.13	65.54	0.68
Area1 Alignment	3200	1:100	83.66	1129.97	1130.81		1130.98	0.011713	1.84	45.40	67.61	0.72
Area1 Alignment	3150	1:50	64.83	1129.74	1130.54		1130.58	0.002837	0.86	75.55	122.38	0.35
Area1 Alignment	3150	1:100	83.66	1129.74	1130.64		1130.68	0.002990	0.96	87.60	125.69	0.37
Area1 Alignment	3100	1:50	64.83	1129.46	1130.07	1130.06	1130.24	0.028193	1.80	35.98	107.18	0.99
Area1 Alignment	3100	1:100	83.66	1129.46	1130.13	1130.13	1130.33	0.028106	1.98	42.21	108.76	1.02
Area1 Alignment	3050	1:50	64.83	1128.07	1128.64	1128.64	1128.87	0.026139	2.14	30.24	65.57	1.01
Area1 Alignment	3050	1:100	83.66	1128.07	1128.73	1128.73	1129.00	0.025037	2.29	36.49	69.27	1.01
Area1 Alignment	3000	1:50	64.83	1122.18	1122.59	1123.05	1125.15	0.521433	7.09	9.15	31.14	4.17
Area1 Alignment	3000	1:100	83.66	1122.18	1122.66	1123.18	1125.45	0.460698	7.41	11.30	32.81	4.03
Area1 Alignment	2950	1:50	64.83	1119.99	1121.51	1120.90	1121.60	0.003116	1.29	50.07	46.79	0.40
Area1 Alignment	2950	1:100	83.66	1119.99	1121.69	1121.04	1121.80	0.003334	1.42	58.72	50.00	0.42
Area1 Alignment	2900	1:50	64.83	1119.98	1121.30		1121.41	0.004568	1.48	43.80	44.60	0.48
Area1 Alignment	2900	1:100	83.66	1119.98	1121.46		1121.59	0.004960	1.64	50.96	47.25	0.50
Area1 Alignment	2850	1:50	64.83	1119.97	1121.05		1121.16	0.005361	1.48	43.69	50.02	0.51
Area1 Alignment	2850	1:100	83.66	1119.97	1121.18		1121.32	0.005908	1.66	50.30	52.20	0.54
Area1 Alignment	2800	1:50	64.83	1119.92	1120.79		1120.88	0.005664	1.35	48.09	66.33	0.51
Area1 Alignment	2800	1:100	83.66	1119.92	1120.90		1121.01	0.006082	1.51	55.38	67.93	0.53
Area1 Alignment	2750	1:50	64.83	1119.74	1120.50		1120.58	0.006329	1.26	51.50	85.64	0.52
Area1 Alignment	2750	1:100	83.66	1119.74	1120.59		1120.69	0.006873	1.42	58.85	86.74	0.55
Area1 Alignment	2700	1:50	64.83	1119.11	1119.81	1119.81	1119.98	0.030141	1.81	35.86	111.74	1.02
Area1 Alignment	2700	1:100	83.66	1119.11	1119.88	1119.88	1120.06	0.027802	1.90	44.01	119.76	1.00
Area1 Alignment	2650	1:50	64.83	1114.34	1114.90	1115.25	1116.40	0.287703	5.44	11.93	38.70	3.13
Area1 Alignment	2650	1:100	83.66	1114.34	1114.96	1115.36	1116.69	0.281114	5.83	14.34	41.11	3.15
Area1 Alignment	2600	1:50	64.83	1110.00	1111.43	1111.13	1111.63	0.008408	1.97	32.98	34.61	0.64
Area1 Alignment	2600	1:100	83.66	1110.00	1111.59	1111.29	1111.83	0.009011	2.16	38.75	37.21	0.68
Area1 Alignment	2550	1:50	64.83	1109.99	1111.22		1111.32	0.004087	1.39	46.50	47.67	0.45
Area1 Alignment	2550	1:100	83.66	1109.99	1111.36		1111.49	0.004470	1.56	53.72	49.90	0.48
Area1 Alignment	2500	1:50	64.83	1109.98	1111.01		1111.10	0.004233	1.33	48.76	55.16	0.45
Area1 Alignment	2500	1:100	83.66	1109.98	1111.14		1111.26	0.004648	1.49	55.98	56.99	0.48
Area1 Alignment	2450	1:50	64.83	1109.94	1110.83		1110.90	0.003747	1.16	56.10	71.53	0.42
Area1 Alignment	2450	1:100	83.66	1109.94	1110.95		1111.03	0.004061	1.30	64.41	73.20	0.44
Area1 Alignment	2400	1:50	64.83	1109.88	1110.70		1110.74	0.002461	0.89	72.54	99.23	0.33
Area1 Alignment	2400	1:100	83.66	1109.88	1110.81		1110.86	0.002608	1.00	83.48	100.45	0.35
Area1 Alignment	2350	1:50	64.83	1109.74	1110.56		1110.60	0.003019	0.94	69.26	103.06	0.36
Area1 Alignment	2350	1:100	83.66	1109.74	1110.66		1110.72	0.003217	1.05	79.58	104.32	0.38
Area1 Alignment	2300	1:50	64.83	1109.49	1110.08	1110.08	1110.25	0.028973	1.84	35.28	104.16	1.01
Area1 Alignment	2300	1:100	83.66	1109.49	1110.14	1110.14	1110.34	0.027895	2.01	41.70	104.91	1.02
Area1 Alignment	2250	1:50	64.83	1104.16	1104.50	1104.86	1106.38	0.457998	6.07	10.68	41.62	3.83
Area1 Alignment	2250	1:100	83.66	1104.16	1104.56	1104.96	1106.63	0.422069	6.37	13.13	44.77	3.76
Area1 Alignment	2200	1:50	64.83	1099.99	1101.14	1100.88	1101.32	0.008579	1.86	34.78	40.22	0.64
Area1 Alignment	2200	1:100	83.66	1099.99	1101.27	1101.02	1101.49	0.009549	2.09	40.11	42.45	0.68
Area1 Alignment	2150	1:50	64.83	1099.95	1100.93		1101.00	0.004007	1.20	54.04	68.54	0.43
Area1 Alignment	2150	1:100	83.66	1099.95	1101.05		1101.14	0.004417	1.34	62.22	71.55	0.46
Area1 Alignment	2100	1:50	64.83	1099.92	1100.78		1100.83	0.002901	0.97	67.01	92.16	0.36
Area1 Alignment	2100	1:100	83.66	1099.92	1100.88		1100.94	0.003200	1.09	76.69	94.79	0.39
Area1 Alignment	2050	1:50	64.83	1099.89	1100.66		1100.69	0.002445	0.82	78.64	120.97	0.33
Area1 Alignment	2050	1:100	83.66	1099.89	1100.75		1100.79	0.002683	0.93	89.93	123.70	0.35
Area1 Alignment	2000	1:50	64.83	1099.86	1100.54		1100.57	0.002380	0.76	85.73	147.14	0.32
Area1 Alignment	2000	1:100	83.66	1099.86	1100.62		1100.66	0.002605	0.86	97.82	149.34	0.34
Area1 Alignment	1950	1:50	64.83	1099.77	1100.14	1100.14	1100.27	0.032062	1.58	41.07	164.36	1.01
Area1 Alignment	1950	1:100	83.66	1099.77	1100.18	1100.18	1100.33	0.030664	1.72	48.69	165.93	1.01
Area1 Alignment	1900	1:50	64.83	1094.40	1094.84	1095.18	1096.37	0.324661	5.49	11.81	41.34	3.28
Area1 Alignment	1900	1:100	83.66	1094.40	1094.90	1095.29	1096.64	0.304811	5.86	14.29	43.31	3.25
Area1 Alignment	1850	1:50	64.83	1090.89	1092.25	1092.28	1092.54	0.029232	2.36	27.48	55.91	1.07
Area1 Alignment	1850	1:100	83.66	1090.89	1092.33	1092.37	1092.68	0.030733	2.64	31.71	56.65	1.13
Area1 Alignment	1800	1:50	64.83	1088.88	1090.11	1090.26	1090.66	0.048658	3.26	19.90	36.01	1.40

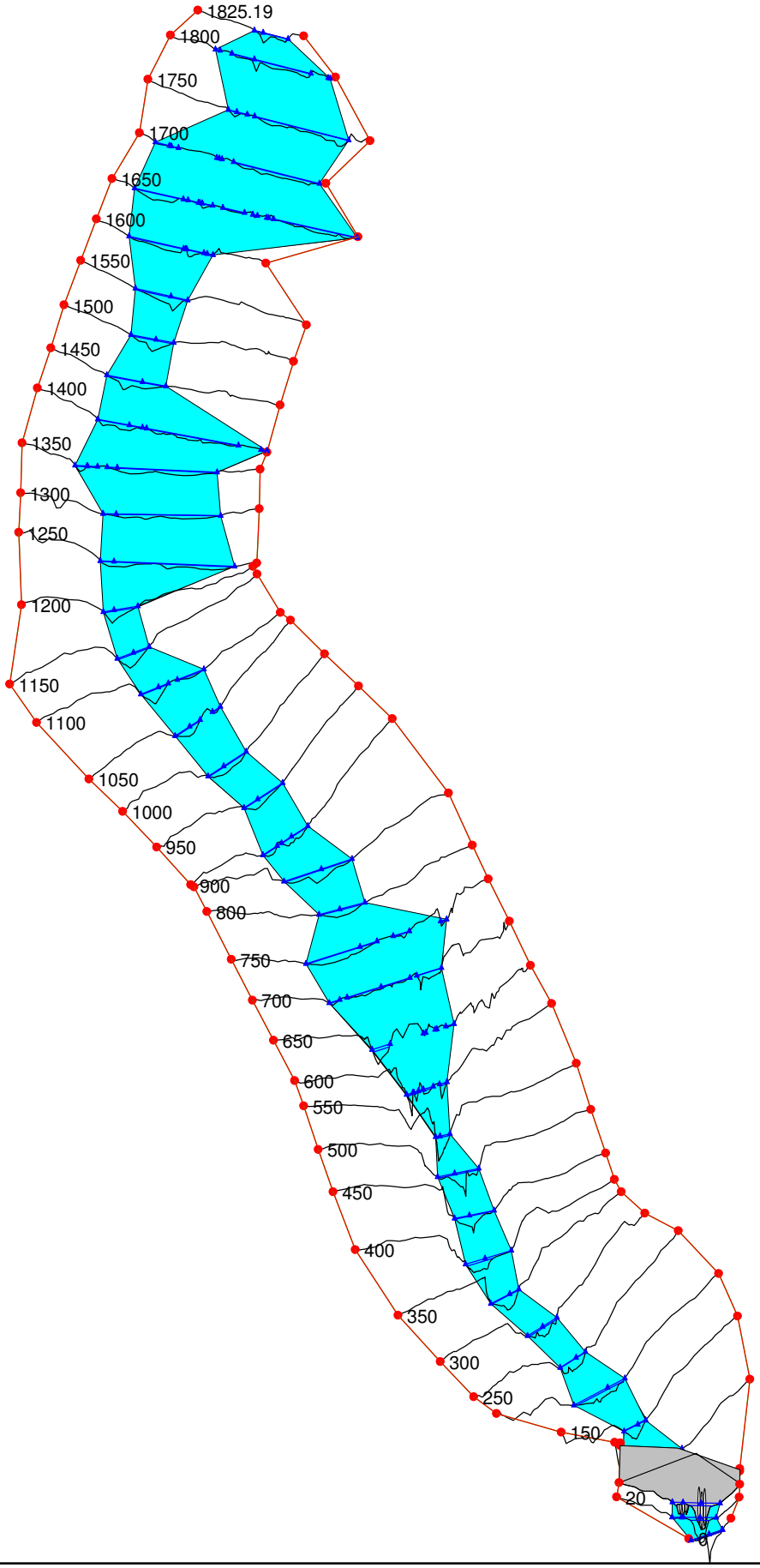
HEC-RAS Plan: Plan 01 River: Stream one Reach: Area1 Alignment (Continued)

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)	
Area1 Alignment	1800	1:100	83.66	1088.88	1090.24	1090.39	1090.84	0.043832	3.43	24.36	37.68	1.36
Area1 Alignment	1750	1:50	64.83	1087.28	1088.86	1088.86	1089.35	0.021565	3.08	21.02	22.06	1.01
Area1 Alignment	1750	1:100	83.66	1087.28	1089.07	1089.07	1089.60	0.020623	3.23	25.90	24.44	1.00
Area1 Alignment	1700	1:50	64.83	1084.73	1085.89	1086.41	1087.36	0.082495	5.36	12.08	15.32	1.93
Area1 Alignment	1700	1:100	83.66	1084.73	1086.06	1086.61	1087.71	0.076044	5.69	14.71	16.01	1.89
Area1 Alignment	1650	1:50	64.83	1084.22	1085.45	1085.45	1085.85	0.022280	2.80	23.16	29.32	1.01
Area1 Alignment	1650	1:100	83.66	1084.22	1085.61	1085.61	1086.06	0.021594	2.97	28.20	31.93	1.01
Area1 Alignment	1600	1:50	64.83	1082.58	1083.83	1083.97	1084.49	0.032590	3.60	18.00	20.86	1.24
Area1 Alignment	1600	1:100	83.66	1082.58	1084.01	1084.17	1084.75	0.030752	3.81	21.95	22.33	1.23
Area1 Alignment	1550	1:50	64.83	1081.27	1082.61	1082.63	1083.11	0.022379	3.13	20.72	22.31	1.04
Area1 Alignment	1550	1:100	83.66	1081.27	1082.76	1082.82	1083.37	0.023771	3.45	24.25	23.57	1.09
Area1 Alignment	1500	1:50	64.83	1080.11	1081.31	1081.40	1081.82	0.029804	3.16	20.52	27.21	1.16
Area1 Alignment	1500	1:100	83.66	1080.11	1081.45	1081.56	1082.05	0.029264	3.42	24.43	28.30	1.18
Area1 Alignment	1450	1:50	64.83	1077.73	1080.31	1079.54	1080.45	0.003253	1.67	38.88	24.95	0.43
Area1 Alignment	1450	1:100	83.66	1077.73	1080.60	1079.73	1080.76	0.003234	1.81	46.34	26.18	0.43
Area1 Alignment	1400	1:50	64.83	1077.73	1079.48	1079.48	1080.07	0.019992	3.40	19.06	16.37	1.01
Area1 Alignment	1400	1:100	83.66	1077.73	1079.73	1079.73	1080.39	0.019011	3.61	23.20	17.53	1.00
Area1 Alignment	1350	1:50	64.83	1076.92	1078.86	1078.57	1079.18	0.009669	2.49	25.99	20.73	0.71
Area1 Alignment	1350	1:100	83.66	1076.92	1079.09	1078.78	1079.47	0.009887	2.71	30.93	22.16	0.73
Area1 Alignment	1300	1:50	64.83	1076.54	1078.48		1078.74	0.007427	2.23	29.01	22.45	0.63
Area1 Alignment	1300	1:100	83.66	1076.54	1078.70		1079.01	0.007726	2.46	34.01	23.40	0.65
Area1 Alignment	1250	1:50	64.83	1076.02	1078.07	1077.71	1078.33	0.008795	2.29	28.30	23.97	0.67
Area1 Alignment	1250	1:100	83.66	1076.02	1078.26	1077.92	1078.59	0.009285	2.54	32.97	24.89	0.70
Area1 Alignment	1200	1:50	64.83	1075.87	1077.25	1077.25	1077.66	0.021634	2.86	22.71	27.39	1.00
Area1 Alignment	1200	1:100	83.66	1075.87	1077.40	1077.40	1077.89	0.021716	3.12	26.84	28.44	1.02
Area1 Alignment	1150	1:50	64.83	1074.89	1077.00	1076.28	1077.12	0.003617	1.53	42.41	34.21	0.44
Area1 Alignment	1150	1:100	83.66	1074.89	1077.24	1076.48	1077.38	0.003484	1.64	51.00	35.93	0.44
Area1 Alignment	1100	1:50	64.83	1074.15	1076.21	1076.21	1076.72	0.021251	3.16	20.53	20.46	1.01
Area1 Alignment	1100	1:100	83.66	1074.15	1076.42	1076.41	1076.99	0.019676	3.34	25.01	21.53	0.99
Area1 Alignment	1050	1:50	64.83	1073.52	1076.07	1075.42	1076.21	0.003774	1.67	38.80	27.54	0.45
Area1 Alignment	1050	1:100	83.66	1073.52	1076.36		1076.52	0.003565	1.79	46.80	28.68	0.45
Area1 Alignment	1000	1:50	64.83	1073.32	1075.22	1075.22	1075.80	0.019976	3.37	19.22	16.60	1.00
Area1 Alignment	1000	1:100	83.66	1073.32	1075.45	1075.45	1076.12	0.019211	3.62	23.14	17.39	1.00
Area1 Alignment	950	1:50	64.83	1072.08	1073.41	1073.66	1074.19	0.058250	3.93	16.49	26.14	1.58
Area1 Alignment	950	1:100	83.66	1072.08	1073.51	1073.81	1074.46	0.064977	4.32	19.34	28.84	1.69
Area1 Alignment	900	1:50	64.83	1071.91	1073.60	1073.11	1073.73	0.004391	1.64	39.55	33.15	0.48
Area1 Alignment	900	1:100	83.66	1071.91	1073.85	1073.25	1074.00	0.004023	1.75	47.85	33.95	0.47
Area1 Alignment	850	1:50	64.83	1070.99	1073.02		1073.37	0.012098	2.64	24.54	21.30	0.79
Area1 Alignment	850	1:100	83.66	1070.99	1073.15	1073.03	1073.62	0.014564	3.04	27.52	22.21	0.87
Area1 Alignment	800	1:50	64.83	1069.43	1072.11	1072.11	1072.54	0.023814	2.90	22.36	27.01	1.02
Area1 Alignment	800	1:100	83.66	1069.43	1072.32	1072.27	1072.77	0.020064	2.97	28.14	28.84	0.96
Area1 Alignment	750	1:50	64.83	1068.90	1071.08	1070.99	1071.50	0.016640	2.89	22.45	21.20	0.90
Area1 Alignment	750	1:100	83.66	1068.90	1071.21	1071.20	1071.77	0.019500	3.30	25.35	22.08	0.98
Area1 Alignment	700	1:50	64.83	1068.41	1070.46		1070.69	0.013839	2.12	30.64	41.23	0.78
Area1 Alignment	700	1:100	83.66	1068.41	1070.60		1070.87	0.013763	2.27	36.79	44.29	0.80
Area1 Alignment	650	1:50	64.83	1067.41	1069.40	1069.40	1069.79	0.023294	2.77	23.38	31.17	1.02
Area1 Alignment	650	1:100	83.66	1067.41	1069.56	1069.56	1070.00	0.021572	2.94	28.41	32.65	1.01
Area1 Alignment	600	1:50	64.83	1066.46	1068.60	1068.04	1068.77	0.005111	1.85	34.96	27.23	0.52
Area1 Alignment	600	1:100	83.66	1066.46	1068.86	1068.24	1069.06	0.004924	1.98	42.27	28.98	0.52
Area1 Alignment	550	1:50	64.83	1066.22	1067.85	1067.79	1068.31	0.017808	3.00	21.61	20.76	0.94
Area1 Alignment	550	1:100	83.66	1066.22	1068.00	1068.00	1068.58	0.020197	3.35	24.95	22.22	1.01
Area1 Alignment	500	1:50	64.83	1065.68	1067.35		1067.56	0.010678	2.03	31.93	38.22	0.71
Area1 Alignment	500	1:100	83.66	1065.68	1067.53	1067.28	1067.76	0.010449	2.13	39.33	43.22	0.71
Area1 Alignment	450	1:50	64.83	1064.59	1066.38	1066.38	1066.80	0.021858	2.85	22.73	27.82	1.01
Area1 Alignment	450	1:100	83.66	1064.59	1066.56	1066.56	1067.02	0.020923	3.00	27.91	30.68	1.00
Area1 Alignment	400	1:50	64.83	1063.23	1065.81	1065.44	1066.04	0.007180	2.08	31.11	25.91	0.61
Area1 Alignment	400	1:100	83.66	1063.23	1066.00	1065.62	1066.28	0.007575	2.32	36.10	26.61	0.64
Area1 Alignment	350	1:50	64.83	1063.66	1065.11	1065.06	1065.48	0.018384	2.69	24.09	28.21	0.93
Area1 Alignment	350	1:100	83.66	1063.66	1065.28	1065.23	1065.70	0.018346	2.88	29.02	30.59	0.94

HEC-RAS Plan: Plan 01 River: Stream one Reach: Area1 Alignment (Continued)

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)	
Area1 Alignment	300	1:50	64.83	1062.76	1064.56	1064.33	1064.77	0.009913	2.04	31.83	35.56	0.69
Area1 Alignment	300	1:100	83.66	1062.76	1064.68	1064.48	1064.95	0.011066	2.30	36.31	36.58	0.74
Area1 Alignment	250	1:50	64.83	1062.70	1063.73	1063.73	1064.01	0.025161	2.35	27.59	50.56	1.02
Area1 Alignment	250	1:100	83.66	1062.70	1063.84	1063.84	1064.17	0.023924	2.52	33.16	52.61	1.01
Area1 Alignment	200	1:50	64.83	1058.18	1063.31	1059.97	1063.33	0.000152	0.58	111.44	33.37	0.10
Area1 Alignment	200	1:100	83.66	1058.18	1063.43	1060.19	1063.45	0.000229	0.73	115.39	33.79	0.13
Area1 Alignment	156.89	1:50	64.83	1058.14	1063.29		1063.32	0.000224	0.67	96.45	31.53	0.12
Area1 Alignment	156.89	1:100	83.66	1058.14	1063.41		1063.44	0.000339	0.84	99.96	32.04	0.15
Area1 Alignment	100	1:50	64.83	1055.59	1063.29		1063.30	0.000154	0.50	130.33	49.64	0.10
Area1 Alignment	100	1:100	83.66	1055.59	1063.40		1063.42	0.000268	0.61	136.22	57.75	0.13
Area1 Alignment	50	1:50	64.83	1055.23	1063.29	1057.81	1063.30	0.000095	0.31	211.84	123.17	0.07
Area1 Alignment	50	1:100	83.66	1055.23	1063.40	1058.09	1063.41	0.000131	0.37	225.16	124.00	0.09
Area1 Alignment	42		Culvert									
Area1 Alignment	0	1:50	64.83	1055.98	1057.42	1057.42	1057.95	0.020248	3.22	20.14	19.11	1.00
Area1 Alignment	0	1:100	83.66	1055.98	1057.64	1057.64	1058.24	0.019437	3.43	24.37	20.31	1.00

Stream two Plan: Plan 02 17/02/2016



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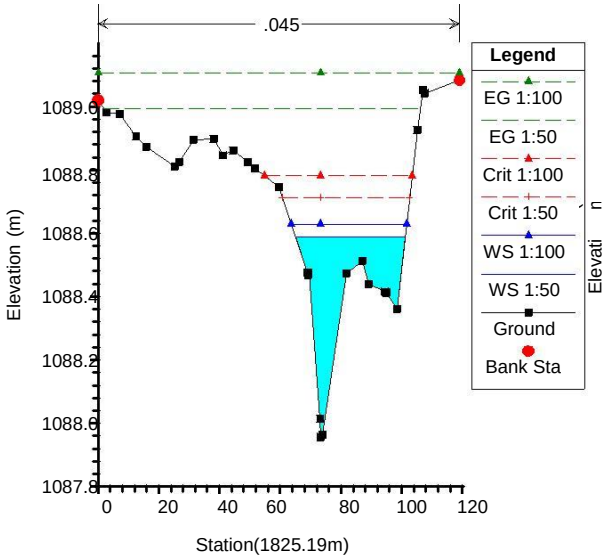

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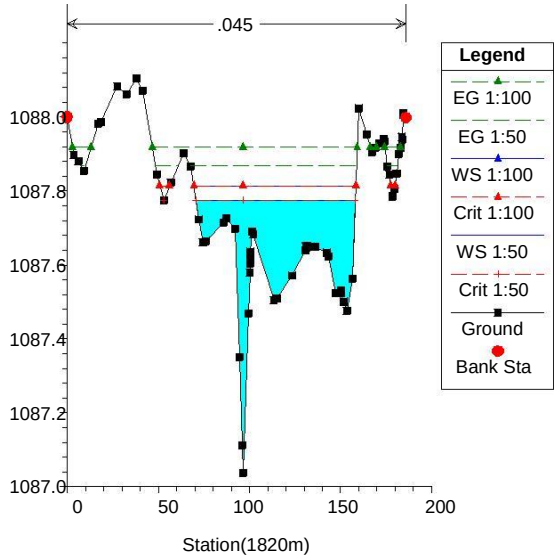

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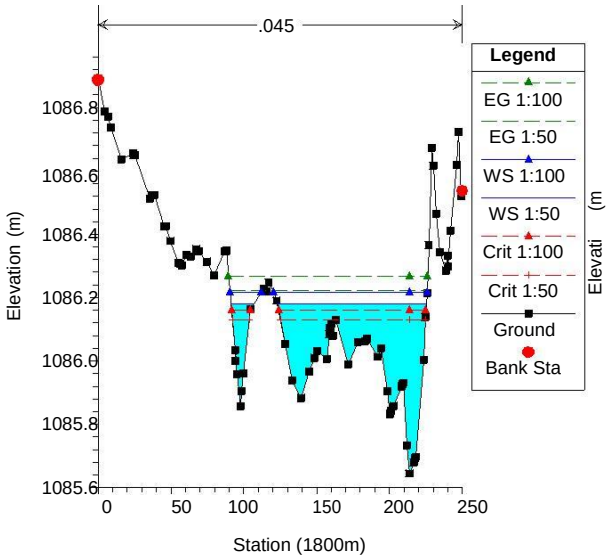

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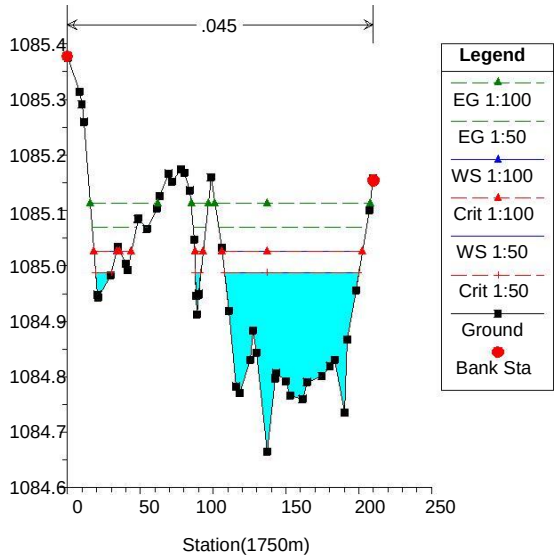

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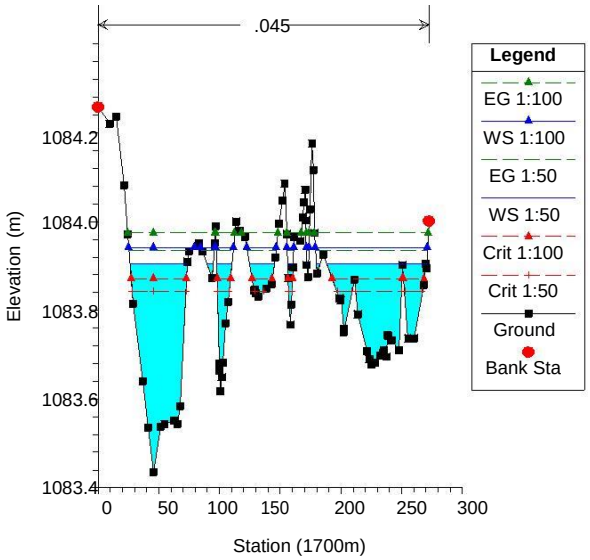

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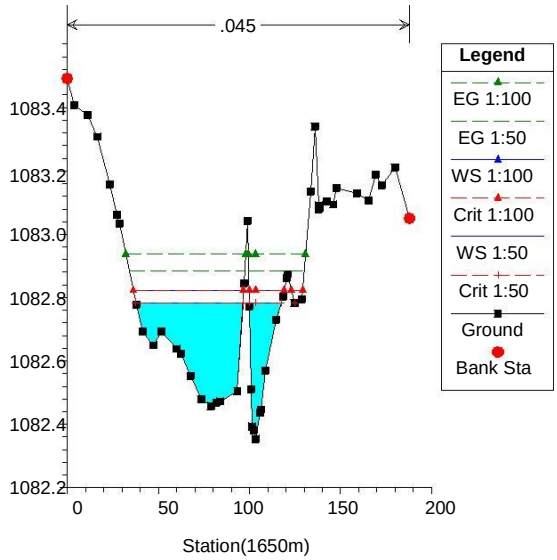

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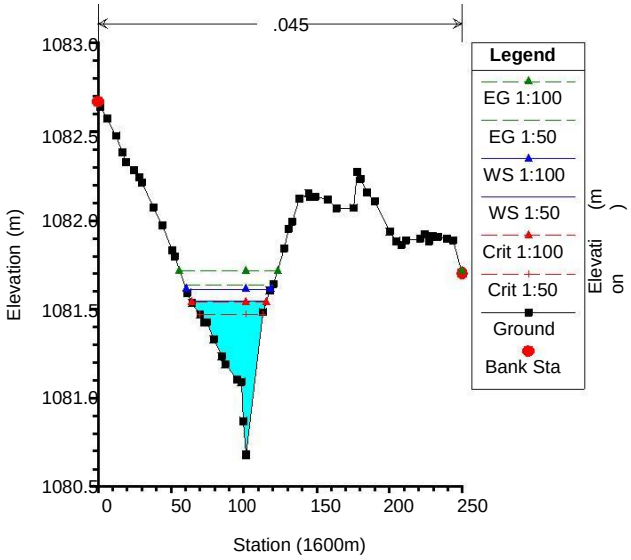

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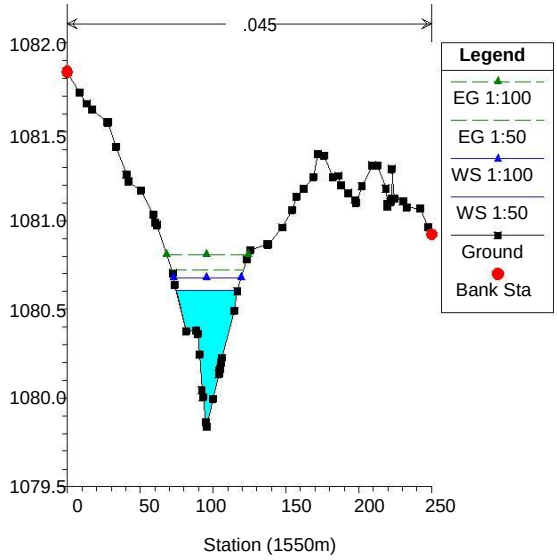

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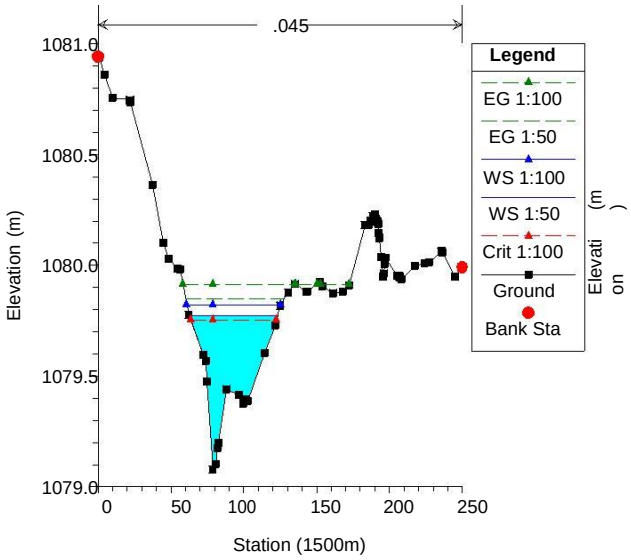
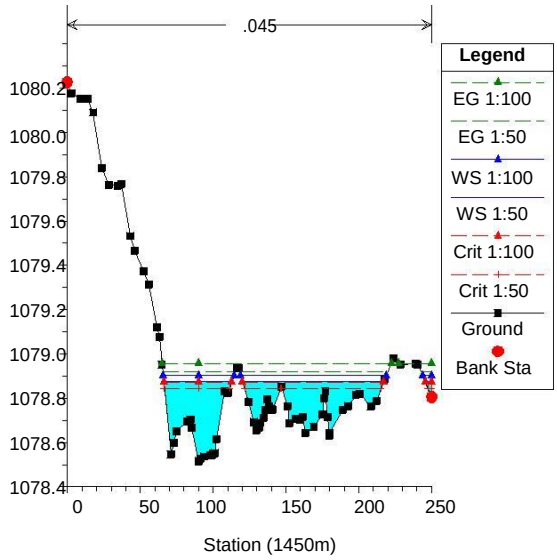
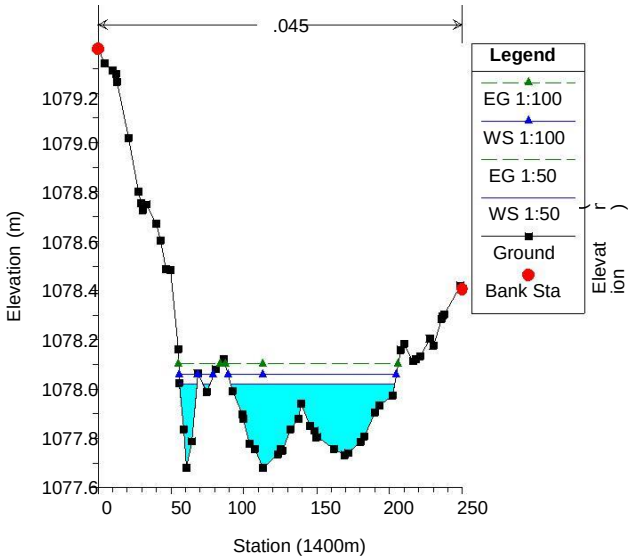


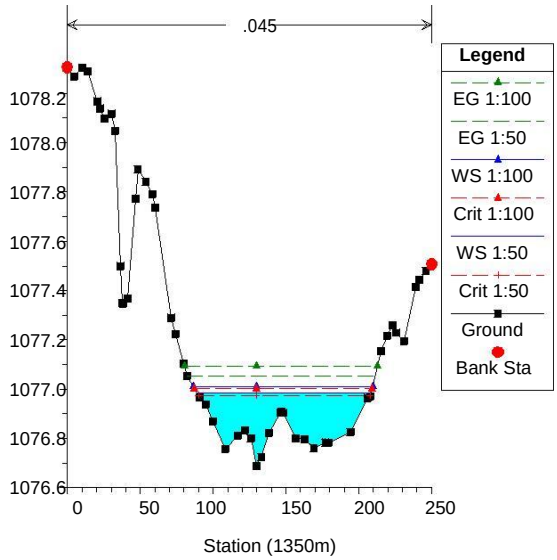
Stream two Plan: Plan 02 17/02/2016



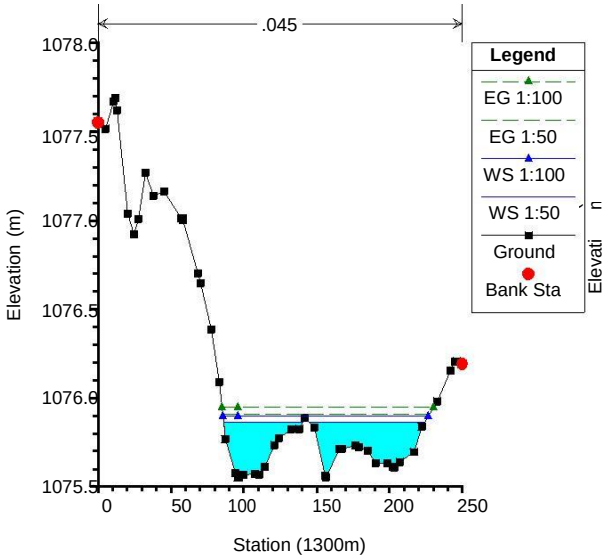
Stream two Plan: Plan 02 17/02/2016



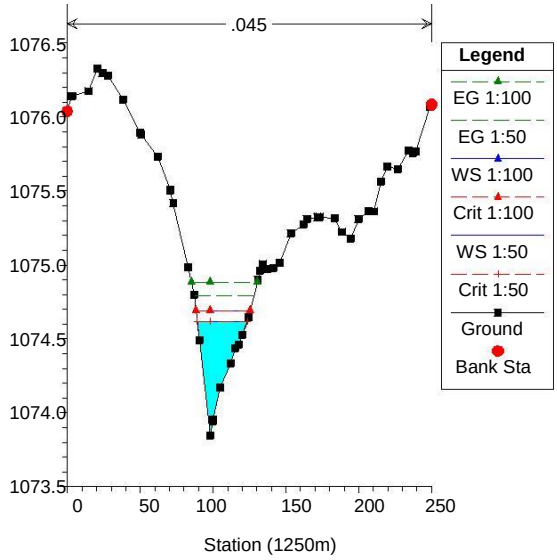
Stream two Plan: Plan 02 17/02/2016



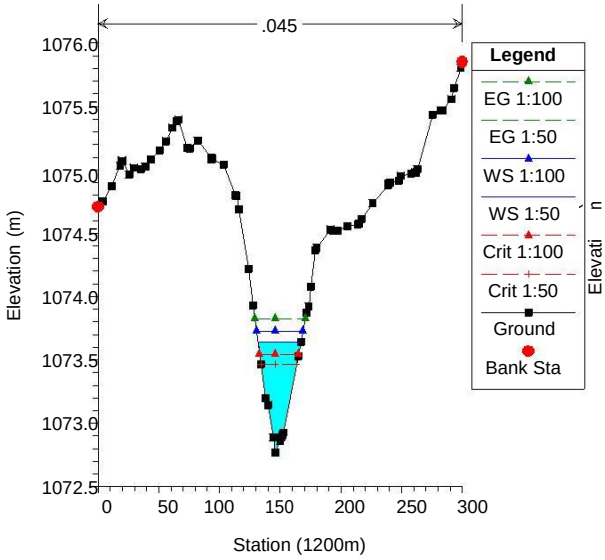
Stream two Plan: Plan 02 17/02/2016



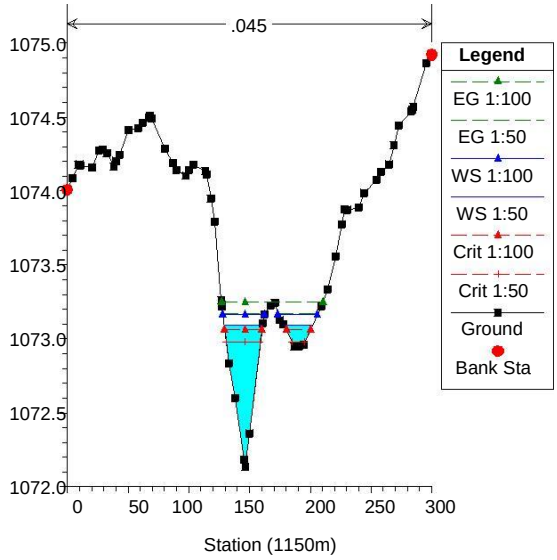
Stream two Plan: Plan 02 17/02/2016



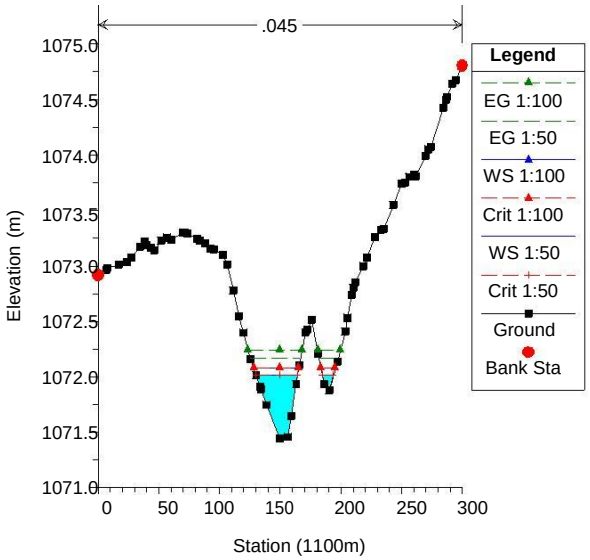
Stream two Plan: Plan 02 17/02/2016



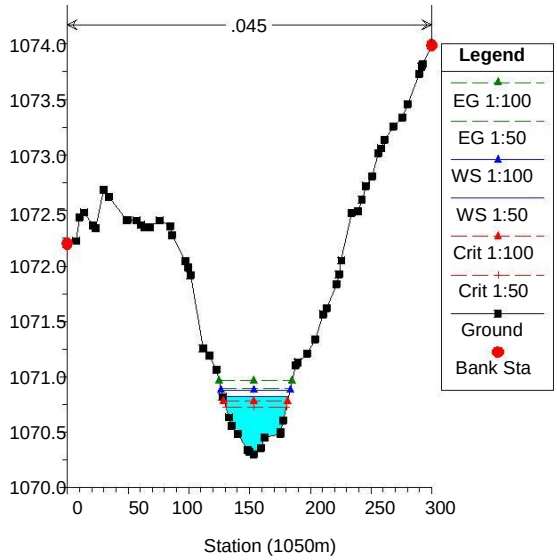
Stream two Plan: Plan 02 17/02/2016



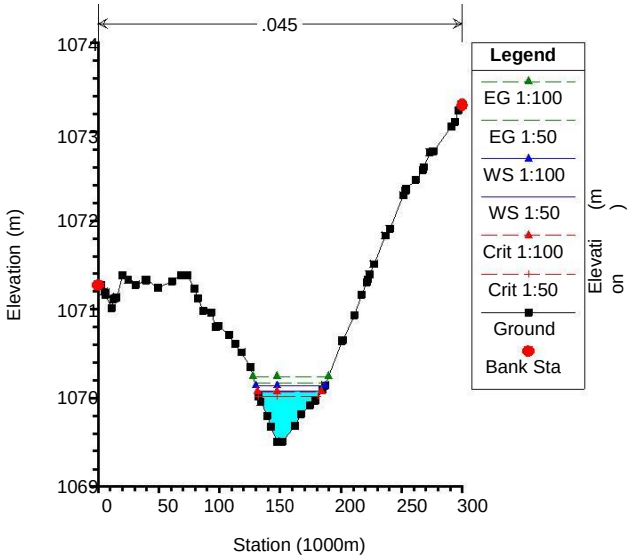
Stream two Plan: Plan 02 17/02/2016



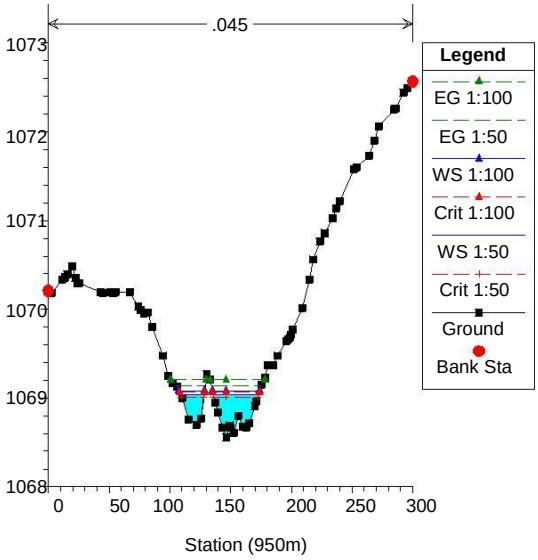
Stream two Plan: Plan 02 17/02/2016



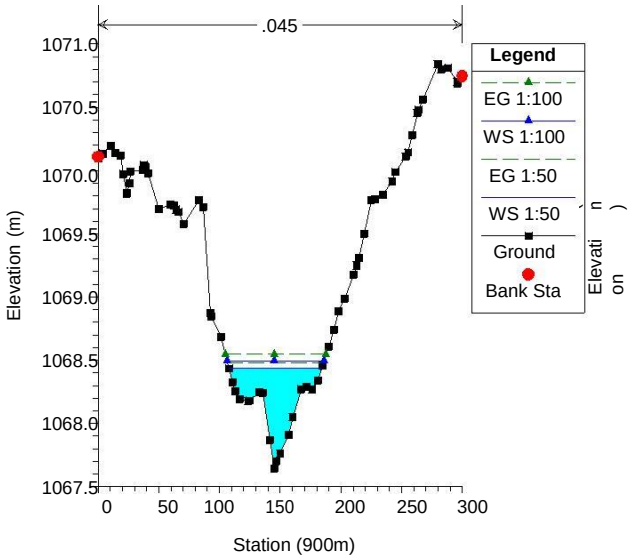
Stream two Plan: Plan 02 17/02/2016



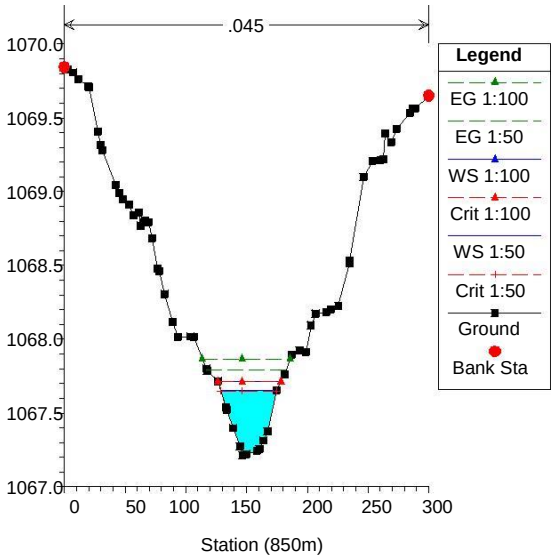
Stream two Plan: Plan 02 17/02/2016



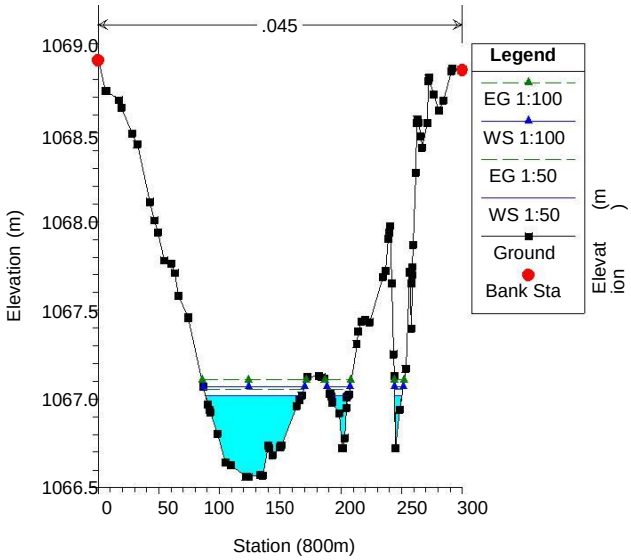
Stream two Plan: Plan 02 17/02/2016



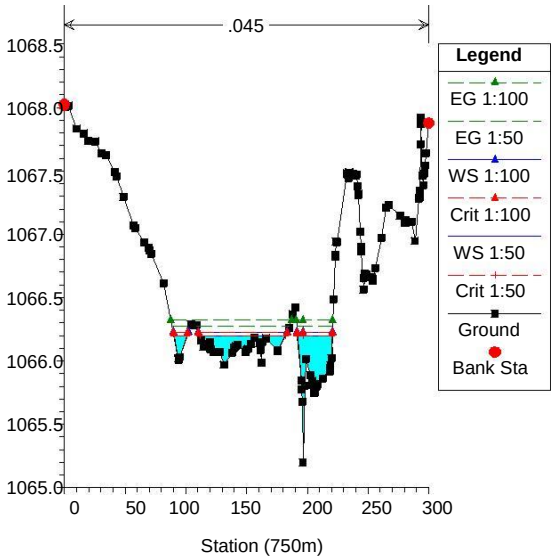
Stream two Plan: Plan 02 17/02/2016



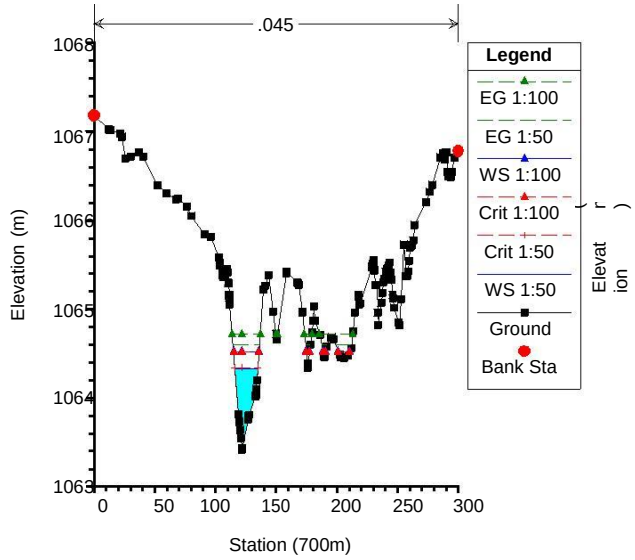
Stream two Plan: Plan 02 17/02/2016



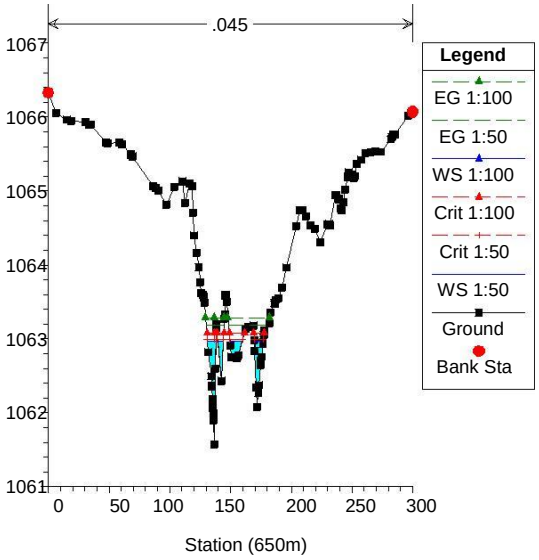
Stream two Plan: Plan 02 17/02/2016



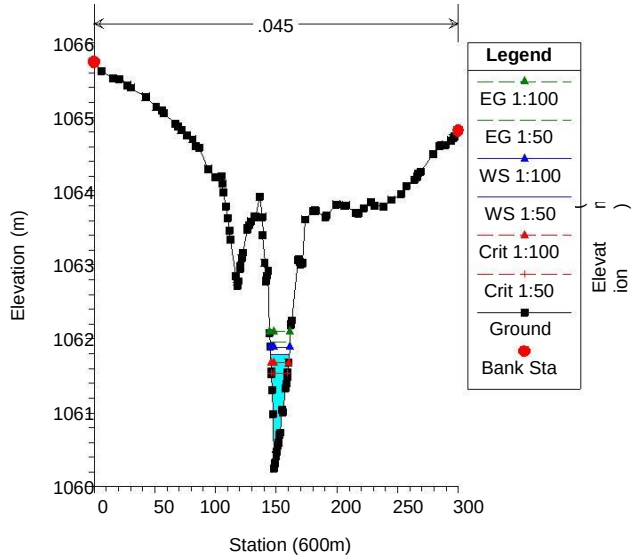
Stream two Plan: Plan 02 17/02/2016



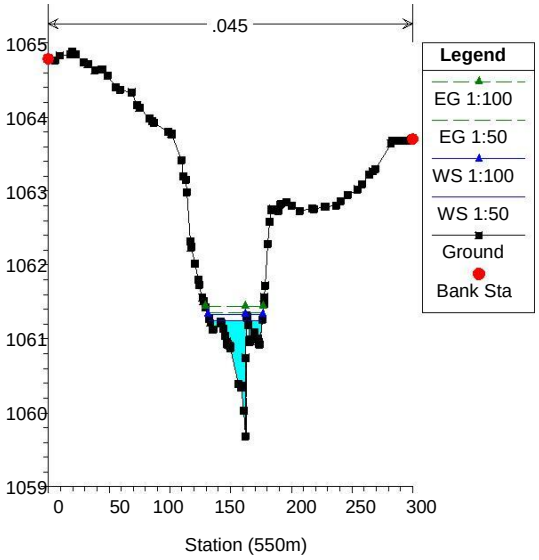
Stream two Plan: Plan 02 17/02/2016



Stream two Plan: Plan 02 17/02/2016



Stream two Plan: Plan 02 17/02/2016



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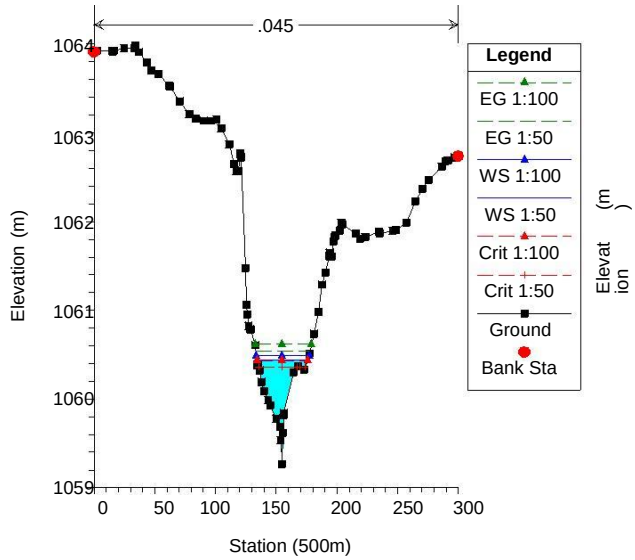
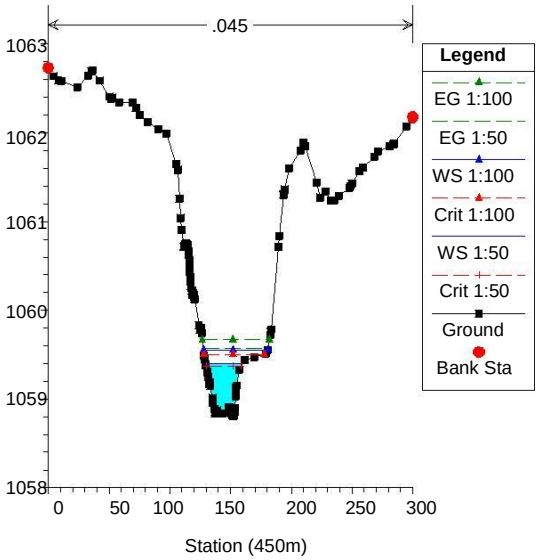
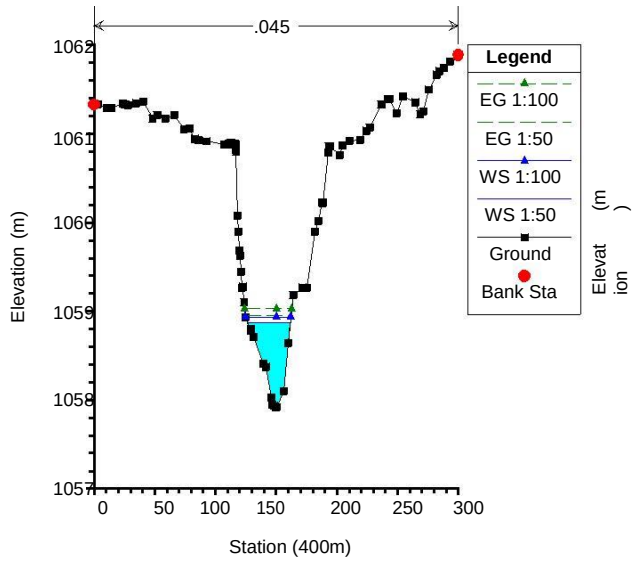


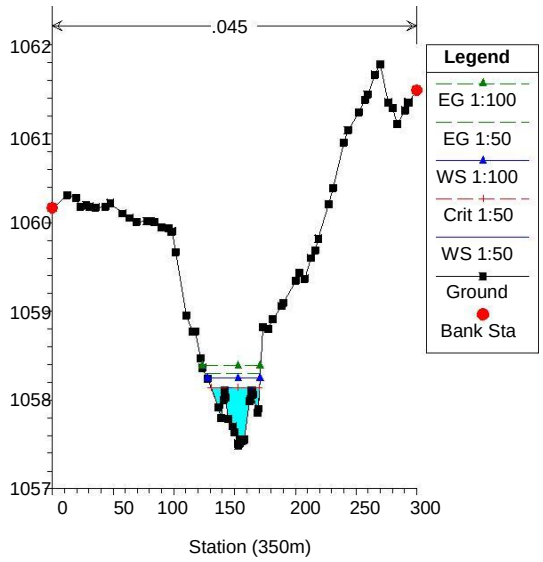
Stream two Plan: Plan 02 17/02/2016



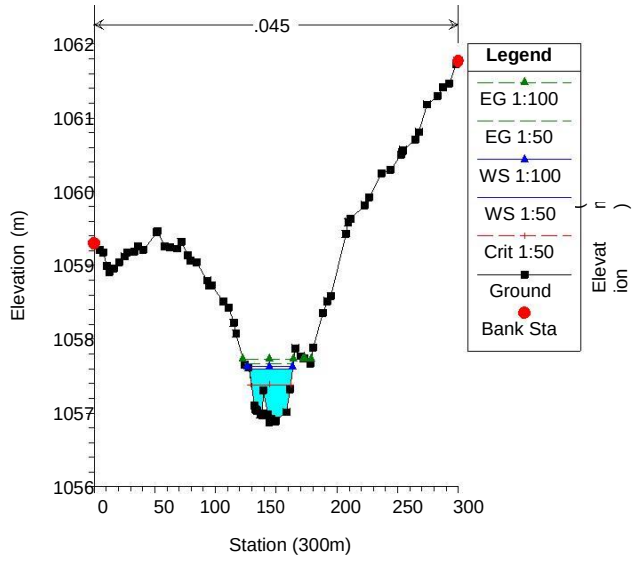
Stream two Plan: Plan 02 17/02/2016



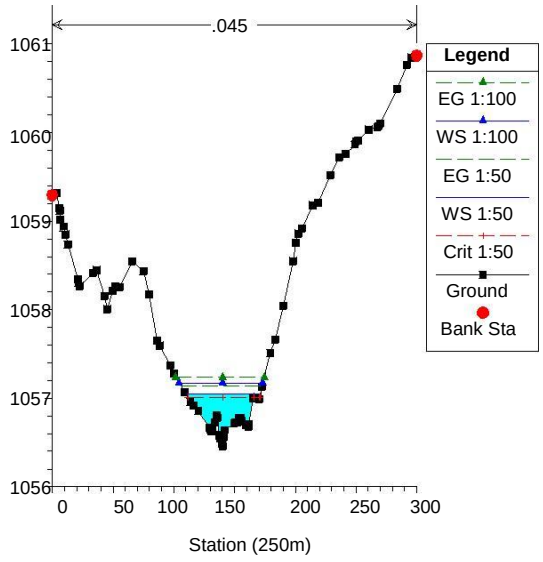
Stream two Plan: Plan 02 17/02/2016



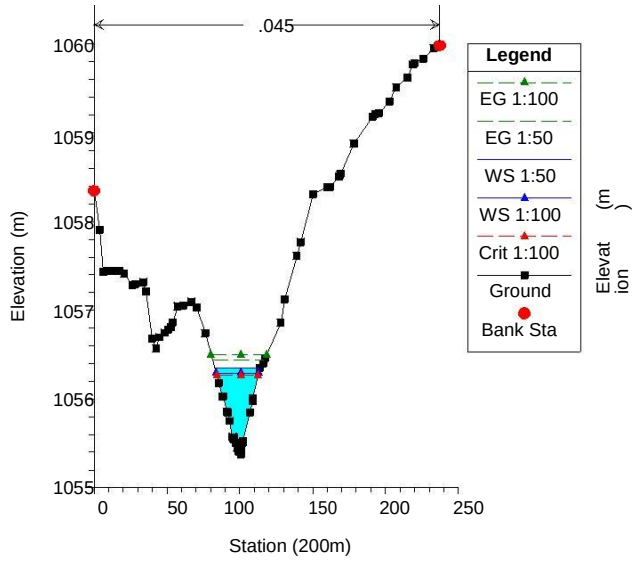
Stream two Plan: Plan 02 17/02/2016



Stream two Plan: Plan 02 17/02/2016



Stream two Plan: Plan 02 17/02/2016



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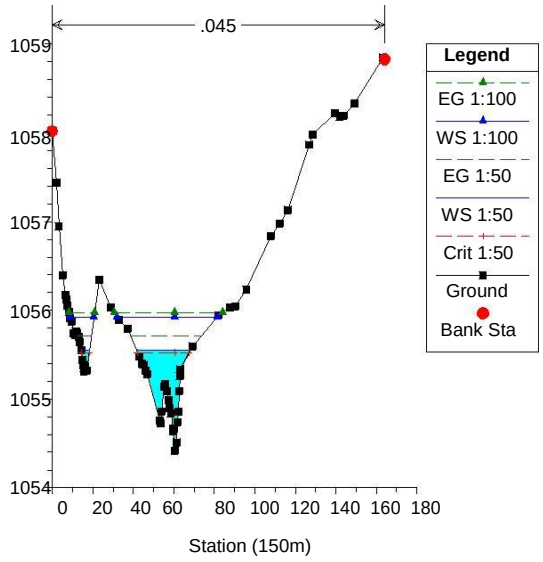
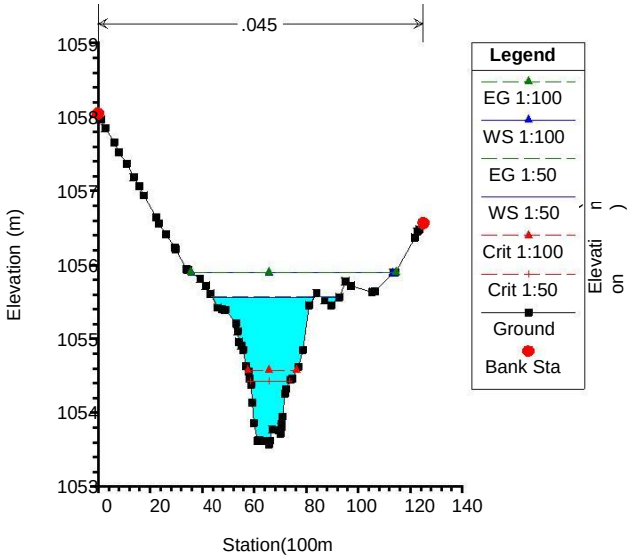
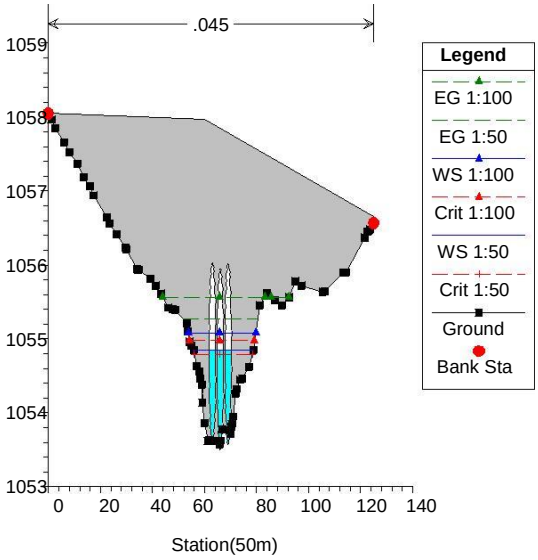


Stream two Plan: Plan 02 17/02/2016



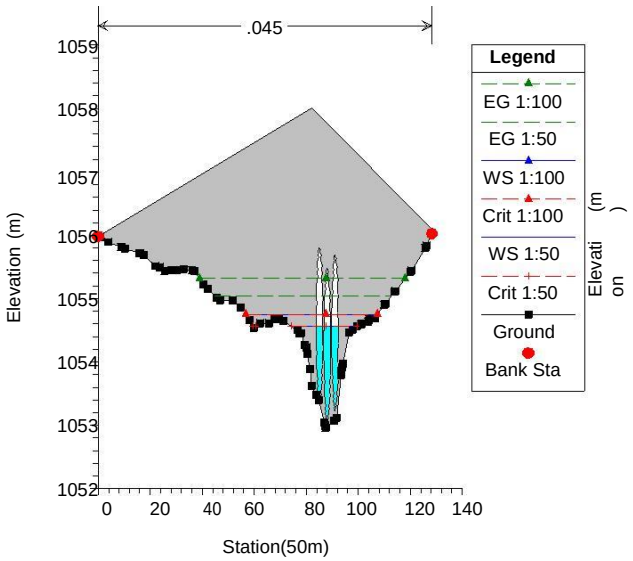
Stream two Plan: Plan 02 17/02/2016

Stream two circular culverts

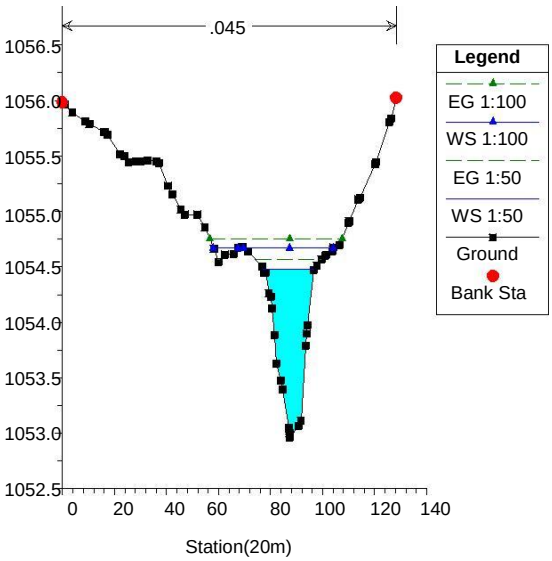


Stream two Plan: Plan 02 17/02/2016

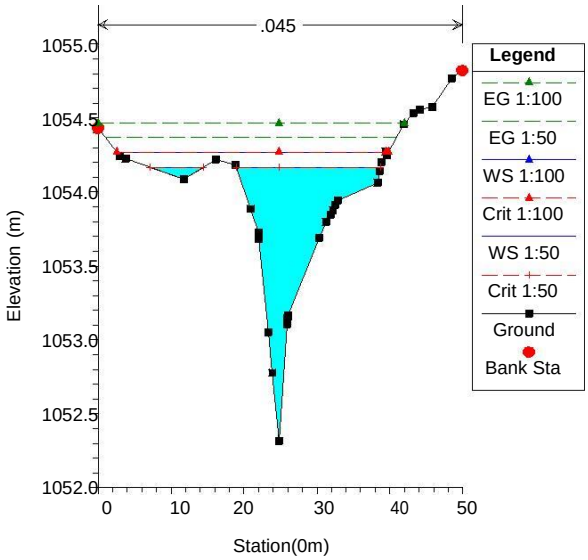
Stream two circular culverts



Stream two Plan: Plan 02 17/02/2016



Stream two Plan: Plan 02 17/02/2016



HEC-RAS Plan: Plan 02 River: Stream two Reach: Area2 Alignment

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)	
Area2 Alignment	1825.19	1:50	21.62	1087.96	1088.59	1088.71	1088.99	0.126898	2.82	7.67	36.03	1.95
Area2 Alignment	1825.19	1:100	27.97	1087.96	1088.63	1088.78	1089.11	0.126914	3.06	9.13	37.86	1.99
Area2 Alignment	1800	1:50	21.62	1087.04	1087.78	1087.78	1087.87	0.035287	1.35	16.05	87.46	1.00
Area2 Alignment	1800	1:100	27.97	1087.04	1087.81	1087.81	1087.92	0.034570	1.43	19.59	96.34	1.01
Area2 Alignment	1750	1:50	21.62	1085.65	1086.18	1086.13	1086.22	0.015420	0.93	23.18	117.86	0.67
Area2 Alignment	1750	1:100	27.97	1085.65	1086.22	1086.16	1086.27	0.015791	1.01	27.69	127.25	0.69
Area2 Alignment	1700	1:50	21.62	1084.67	1084.99	1084.99	1085.07	0.037820	1.27	17.04	107.02	1.02
Area2 Alignment	1700	1:100	27.97	1084.67	1085.03	1085.03	1085.11	0.036695	1.31	21.39	125.66	1.01
Area2 Alignment	1650	1:50	21.62	1083.44	1083.91	1083.84	1083.94	0.014195	0.77	27.99	177.60	0.62
Area2 Alignment	1650	1:100	27.97	1083.44	1083.94	1083.87	1083.98	0.013661	0.80	34.93	204.01	0.62
Area2 Alignment	1600	1:50	21.62	1082.35	1082.78	1082.78	1082.88	0.033694	1.40	15.42	76.40	1.00
Area2 Alignment	1600	1:100	27.97	1082.35	1082.82	1082.82	1082.94	0.034614	1.49	18.71	86.01	1.02
Area2 Alignment	1550	1:50	21.62	1080.68	1081.55	1081.47	1081.64	0.017403	1.35	16.07	51.61	0.77
Area2 Alignment	1550	1:100	27.97	1080.68	1081.61	1081.54	1081.72	0.017187	1.42	19.74	58.11	0.78
Area2 Alignment	1500	1:50	21.62	1079.84	1080.61		1080.72	0.019149	1.50	14.40	42.16	0.82
Area2 Alignment	1500	1:100	27.97	1079.84	1080.68		1080.81	0.019066	1.60	17.50	46.51	0.83
Area2 Alignment	1450	1:50	21.62	1079.08	1079.77		1079.85	0.015701	1.22	17.67	60.66	0.72
Area2 Alignment	1450	1:100	27.97	1079.08	1079.82	1079.75	1079.92	0.016410	1.34	20.85	64.44	0.75
Area2 Alignment	1400	1:50	21.62	1078.52	1078.88	1078.84	1078.92	0.021787	0.94	22.93	148.60	0.77
Area2 Alignment	1400	1:100	27.97	1078.52	1078.90	1078.87	1078.96	0.021942	1.03	27.18	155.32	0.79
Area2 Alignment	1350	1:50	21.62	1077.68	1078.02		1078.06	0.013877	0.87	24.80	129.00	0.63
Area2 Alignment	1350	1:100	27.97	1077.68	1078.06		1078.10	0.013552	0.93	30.00	138.58	0.64
Area2 Alignment	1300	1:50	21.62	1076.69	1076.98	1076.97	1077.05	0.031466	1.15	18.82	119.69	0.92
Area2 Alignment	1300	1:100	27.97	1076.69	1077.01	1077.00	1077.09	0.033046	1.28	21.90	123.13	0.97
Area2 Alignment	1250	1:50	21.62	1075.55	1075.86		1075.91	0.017240	0.92	23.58	133.79	0.70
Area2 Alignment	1250	1:100	27.97	1075.55	1075.90		1075.95	0.016584	0.98	28.43	140.99	0.70
Area2 Alignment	1200	1:50	21.62	1073.85	1074.62	1074.62	1074.79	0.029351	1.86	11.65	34.16	1.01
Area2 Alignment	1200	1:100	27.97	1073.85	1074.69	1074.69	1074.88	0.027485	1.95	14.35	37.23	1.00
Area2 Alignment	1150	1:50	21.62	1072.77	1073.64	1073.47	1073.73	0.008994	1.28	16.86	35.48	0.59
Area2 Alignment	1150	1:100	27.97	1072.77	1073.73	1073.55	1073.83	0.009526	1.40	19.96	38.37	0.62
Area2 Alignment	1100	1:50	21.62	1072.13	1073.09	1072.98	1073.17	0.014033	1.23	17.60	55.12	0.69
Area2 Alignment	1100	1:100	27.97	1072.13	1073.17	1073.06	1073.25	0.014298	1.27	22.03	66.60	0.70
Area2 Alignment	1050	1:50	21.62	1071.44	1072.02	1072.02	1072.17	0.030704	1.71	12.64	43.34	1.01
Area2 Alignment	1050	1:100	27.97	1071.44	1072.08	1072.08	1072.24	0.029679	1.78	15.67	49.20	1.01
Area2 Alignment	1000	1:50	21.62	1070.30	1070.82	1070.73	1070.89	0.012457	1.19	18.16	54.60	0.66
Area2 Alignment	1000	1:100	27.97	1070.30	1070.88	1070.78	1070.97	0.012552	1.30	21.52	57.02	0.68
Area2 Alignment	950	1:50	21.62	1069.50	1070.08	1070.01	1070.17	0.016922	1.32	16.40	53.20	0.76
Area2 Alignment	950	1:100	27.97	1069.50	1070.14	1070.07	1070.24	0.016798	1.42	19.75	57.29	0.77
Area2 Alignment	900	1:50	21.62	1068.56	1069.03	1069.01	1069.14	0.025212	1.45	14.89	56.33	0.90
Area2 Alignment	900	1:100	27.97	1068.56	1069.08	1069.07	1069.21	0.025811	1.58	17.71	60.16	0.93
Area2 Alignment	850	1:50	21.62	1067.64	1068.44		1068.48	0.007761	0.90	23.97	76.57	0.51
Area2 Alignment	850	1:100	27.97	1067.64	1068.50		1068.55	0.007595	0.98	28.67	80.14	0.52
Area2 Alignment	800	1:50	21.62	1067.21	1067.65	1067.65	1067.79	0.029345	1.65	13.12	46.10	0.99
Area2 Alignment	800	1:100	27.97	1067.21	1067.71	1067.71	1067.87	0.029603	1.75	16.02	51.90	1.00
Area2 Alignment	750	1:50	21.62	1066.56	1067.02		1067.05	0.008301	0.83	26.02	98.91	0.52
Area2 Alignment	750	1:100	27.97	1066.56	1067.07		1067.11	0.008569	0.89	31.27	108.96	0.53
Area2 Alignment	700	1:50	21.62	1065.20	1066.20	1066.20	1066.28	0.038025	1.26	17.21	109.75	1.01
Area2 Alignment	700	1:100	27.97	1065.20	1066.23	1066.23	1066.32	0.037352	1.36	20.53	114.39	1.03
Area2 Alignment	650	1:50	21.62	1063.42	1064.33	1064.34	1064.60	0.026586	2.28	9.50	18.98	1.03
Area2 Alignment	650	1:100	27.97	1063.42	1064.52	1064.52	1064.72	0.027392	1.98	14.12	35.53	1.00
Area2 Alignment	600	1:50	21.62	1061.57	1062.97	1063.00	1063.19	0.037573	2.10	10.28	28.78	1.12
Area2 Alignment	600	1:100	27.97	1061.57	1063.08	1063.08	1063.29	0.030000	2.04	13.70	34.03	1.03
Area2 Alignment	550	1:50	21.62	1060.24	1061.79	1061.53	1061.95	0.008916	1.77	12.21	15.23	0.63
Area2 Alignment	550	1:100	27.97	1060.24	1061.89	1061.68	1062.10	0.010858	2.05	13.66	15.88	0.70
Area2 Alignment	500	1:50	21.62	1059.68	1061.25		1061.35	0.016020	1.41	15.36	42.13	0.74
Area2 Alignment	500	1:100	27.97	1059.68	1061.33		1061.44	0.014609	1.47	18.97	45.31	0.73
Area2 Alignment	450	1:50	21.62	1059.27	1060.44	1060.36	1060.54	0.016376	1.43	15.07	41.88	0.76
Area2 Alignment	450	1:100	27.97	1059.27	1060.49	1060.43	1060.62	0.018695	1.63	17.15	43.39	0.83
Area2 Alignment	400	1:50	21.62	1058.81	1059.40	1059.37	1059.57	0.023205	1.79	12.06	31.19	0.92

HEC-RAS Plan: Plan 02 River: Stream two Reach: Area2 Alignment (Continued)

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)	
Area2 Alignment	400	1:100	27.97	1058.81	1059.55	1059.50	1059.67	0.019196	1.52	18.43	53.18	0.82
Area2 Alignment	350	1:50	21.62	1057.91	1058.88		1058.95	0.007150	1.20	18.08	35.50	0.54
Area2 Alignment	350	1:100	27.97	1057.91	1058.93		1059.03	0.008928	1.39	20.19	37.56	0.60
Area2 Alignment	300	1:50	21.62	1057.48	1058.14	1058.14	1058.30	0.029559	1.75	12.35	39.68	1.00
Area2 Alignment	300	1:100	27.97	1057.48	1058.25		1058.39	0.019830	1.67	16.79	43.13	0.85
Area2 Alignment	250	1:50	21.62	1056.87	1057.60	1057.38	1057.66	0.006448	1.15	18.74	35.89	0.51
Area2 Alignment	250	1:100	27.97	1056.87	1057.63		1057.73	0.009102	1.40	20.00	37.17	0.61
Area2 Alignment	200	1:50	21.62	1056.46	1057.05	1057.00	1057.13	0.020244	1.31	16.50	61.83	0.81
Area2 Alignment	200	1:100	27.97	1056.46	1057.17		1057.24	0.010260	1.13	24.67	68.96	0.60
Area2 Alignment	150	1:50	21.62	1055.38	1056.34		1056.44	0.009962	1.40	15.42	30.60	0.63
Area2 Alignment	150	1:100	27.97	1055.38	1056.29	1056.26	1056.50	0.022135	2.02	13.86	29.01	0.93
Area2 Alignment	100	1:50	21.62	1054.42	1055.55	1055.52	1055.71	0.022935	1.79	12.07	30.71	0.91
Area2 Alignment	100	1:100	27.97	1054.42	1055.93		1055.97	0.005293	0.97	28.82	61.52	0.45
Area2 Alignment	60	1:50	21.62	1053.57	1055.56	1054.43	1055.57	0.000839	0.57	38.10	45.56	0.20
Area2 Alignment	60	1:100	27.97	1053.57	1055.89	1054.58	1055.90	0.000656	0.47	59.08	77.43	0.17
Area2 Alignment	55		Culvert									
Area2 Alignment	20	1:50	21.62	1052.96	1054.48		1054.56	0.004568	1.32	16.41	19.64	0.46
Area2 Alignment	20	1:100	27.97	1052.96	1054.67		1054.75	0.008147	1.26	22.17	44.10	0.57
Area2 Alignment	0	1:50	21.62	1052.32	1054.17	1054.17	1054.37	0.027886	1.99	10.88	27.09	1.00
Area2 Alignment	0	1:100	27.97	1052.32	1054.27	1054.27	1054.46	0.028444	1.95	14.31	37.28	1.01

ANNEXURE F

1:50 and 1:100 Year Floodline Alignment

AS-BUILT RECORD			
CONTRACT No.	DESCRIPTION	CERTIFIED BY	DATE

CERTIFIED AS-BUILT FOR CONTRACT :

ENGINEER DATE

VERSION/AMENDMENTS			
No.	DATE	DESCRIPTION	AUTHORISED BY

BIGEN AFRICA Services (PTY) LTD
Allan Cormack Street
The Innovation Hub Persequor Pretoria
PO Box 29 The Innovation Hub Pretoria 0087
Tel:+ 27 (0) 12 842 8700
Fax:+ 27 (0) 12 843 9000/9001
E-mail: pretoria@bigenafrica.com
www.bigenafrica.com

PROJECT TITLE:

BAKUBUNG LEDIG
MIXED-USE DEVELOPMENT

DRAWING TITLE:

FLOODLINE ALIGNMENT

0 50 100
100mm ON ORIGINAL DRAWING

ORIGINAL DRAWING SCALE:	NTS	ORIGINAL DRAWING SHEET SIZE:	A1

APPROVED:

CLIENT OR ASSIGNEE: _____ DATE: _____

CLIENT DRAWING No.: | CLIENT REF No.:

SURVEYED	-	DESIGNED	-
DRAWN	G. Bezuidenhout	CHECKED	D. Storbeck
CO-ORDINATE SYSTEM:	WG29	DATE:	August 2016

APPROVED ON BEHALF OF BIGEN AFRICA:

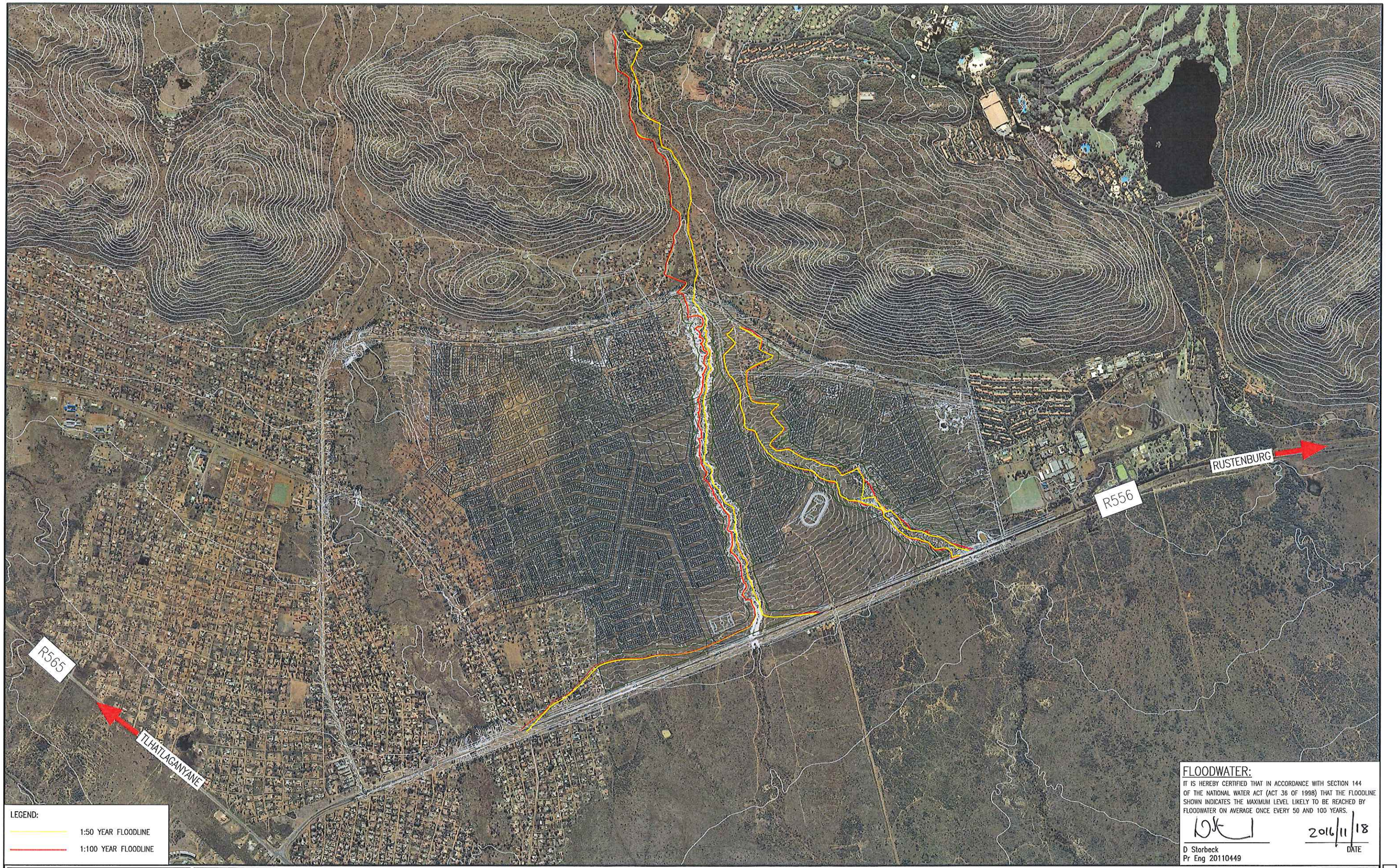
ENGINEER: _____ DATE: _____

DRAWING No.:	VERSION:
2734.20.ZA.04.A002	A.0

2734.20.ZA.04.A002

ANNEXURE G

1:50 and 1:100 Year Floodline



LEGEND:

1:50 YEAR FLOODLINE

1:100 YEAR FLOODLINE

FLOODWATER:

IT IS HEREBY CERTIFIED THAT IN ACCORDANCE WITH SECTION 144 OF THE NATIONAL WATER ACT (ACT 36 OF 1998) THAT THE FLOODLINE SHOWN INDICATES THE MAXIMUM LEVEL LIKELY TO BE REACHED BY FLOODWATER ON AVERAGE ONCE EVERY 50 AND 100 YEARS.

D Storbeck
Pr Eng 20110449

2016/11/18
DATE

AS-BUILT RECORD

CONTRACT No.	DESCRIPTION	CERTIFIED BY	DATE

CERTIFIED AS-BUILT FOR CONTRACT :

ENGINEER _____ DATE _____

VERSION/AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED BY

BIGEN AFRICA Services (PTY) LTD
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The Innovation Hub Persequor Pretoria
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Fax:+ 27 (0) 12 843 9000/9001
E-mail: pretoria@bigenafrica.com
www.bigenafrica.com

BIGEN AFRICA

Engineering solutions

PROJECT TITLE:

BAKUBUNG LEDIG
MIXED-USE DEVELOPMENT

DRAWING TITLE:

1:50 AND 1:100 YEAR FLOODLINE

0 50 100
100mm ON ORIGINAL DRAWING

ORIGINAL DRAWING SCALE:	NTS	ORIGINAL DRAWING SHEET SIZE:	A1

APPROVED:

CLIENT OR ASSIGNEE: _____ DATE: _____

CLIENT DRAWING No.:	CLIENT REF No.:

SURVEYED	-	DESIGNED	-
DRAWN	G. Bezuidenhout	CHECKED	D. Storbeck
CO-ORDINATE SYSTEM:	WG29	DATE:	August 2016

APPROVED ON BEHALF OF BIGEN AFRICA:

ENGINEER: _____ DATE: _____

DRAWING No.:	VERSION:
2734.20.ZA.04.A004	A.0

2734.20.ZA.04.A004