NAVACHAB MINE

FLOOD HYDROLOGY AND FLOODLINE ASSESSMENT

REPORT 303-00417/02-01

JULY 2012

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TABLE OF CONTENTS

		PAGE
1	INTRODUCTION	1
1.1	Aims	1
2	FLOOD HYDROLOGY ASSESSMENT	2
2.1	Catchment Characteristics	2
2.2	Rainfall Information	3
3	FLOOD PEAK DETERMINATION	5
3.1	Rational Method	5
3.2	Alternative Rational Method	6
3.3	Unit Hydrograph Method	7
3.4	Empirical Flood Peak Estimate	7
4	FLOOD ASSESSMENT	9
5	FLOOD INUNDATION LINES	11
6	POTENTIAL MITIGATION MEASURES	12
6.1	Diversion Canals	12
6.2	Diversion Culvert	15
7	CONCLUSIONS AND RECOMMENDATIONS	16
8	REFERENCES	17

LIST OF FIGURES

Figure 2.1 : Significant streams, tributaries and sub-catchment areas 3
Figure 6.1 : Proposed Canal A alignment 13
Figure 6.2 : Proposed Canal B1 and B2 alignments 13
Figure 6.3 : Proposed canal and culvert alignment for Stream B 15

DRAFT

LIST OF TABLES

Table 2.1 : Catchment Characteristics 2
Table 2.2 : Characteristics of Rainfall Station - 826596 4
Table 2.3 : Design Rainfall for Station - 740154.....4
Table 3.1 : Flood Peaks calculated using the Rational Method 6
Table 3.2 : Flood Peaks calculated using the Alternative Rational Method 6
Table 3.3 : Flood Peaks calculated using the SUH Method 7
Table 3.4 : Flood Peaks calculated using the RMF Method.....8
Table 4.1 : 1:50 year Flood Peak Summary.....9
Table 4.2 : 1:100 year Flood Peak Summary.....9
Table 6.1 : Diversion Canal sizes for the 1:50 yr flood events 14
Table 6.2 : Diversion Canal sizes for the 1:100 yr flood events 14
Table 6.3 : Diversion Canal B sizes for the 1:50 and 1:100 yr flood events.....15

LIST OF APPENDICES

APPENDIX A Catchment Areas of the Significant Streams in Project Area
APPENDIX B Combined Survey Mapping
APPENDIX C 1:50 and 1:100 yr Flood Inuandation Mapping
APPENDIX D HEC-RAS Cross Section Palns
APPENDIX E HEC-RAS Output Files

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1 INTRODUCTION

Knight Piésold (Pty) Ltd was appointed by AngloGold Ashanti to conduct a specialist assessment of the floodlines associated with all the significant streams running through the existing Navachab Mine in Namiba.

The report is based on a review of available data including survey data and rainfall records provided by the Client. The report provides baseline information, assesses potential impacts, and recommends mitigation measures, where appropriate.

The main objective of this report is to determine the 1:50 and 1:100 year floodlines of the natural stream that flows through the Navachab Mine.

1.1 Aims

The aims of this report were:

- ***Flood Hydrology Assessment:*** To determine the 1:10, 1:20, 1:50 and 1:100 year flood peaks for the streams that flow through the project area, using both deterministic and empirical methods;
- ***Floodline Development***: Use HEC-RAS software to determine the flood inundation area for all the significant streams running through the project area; and
- ***Mitigation:*** Development of flood alleviation measures to reduce impact of flooding.

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2 FLOOD HYDROLOGY ASSESSMENT

The methods chosen to determine the flood discharges were both deterministic (The Rational method and Synthetic Unit Hydrograph method) and empirical (Regional Maximum Flood method). These models are built into the Utility Programs for Drainage Software (UPD) which has been used for the flood determination. The calculation of design floods requires the evaluation of the catchment runoff characteristics and return period storm rainfall depths.

2.1 Catchment Characteristics

The total catchment area, contributing to the runoff in the project area, is 308.085 km^2. There are three significant streams flowing through the project area. Stream A flows through the project area to the north of the plant, Stream B flows between the plant and the pit and Stream C runs to the south west of the pit. These three streams have an number smaller triburaties, of which eight have been identified as significant for the purposes of this study. The catchment areas are shown in Figure 2.1 and **Appendix A**.

All the runoff that passes through the project area flows into the Kahn river. Each of the eleven streams will be evaluated for the purposes of the determining both the flood peaks and the floodlines. The catchment characteristics of the eleven stream catchments are summarised in Table 2.1. Catchments D and E were not analysed as the streams are not covered by the detailed survey data and the streams only pass through a small remote section of the project area, located far away from the plant and pit.

Table 2.1 : Catchment Characteristics

Catchment	Catchment Area (km^2)	Longest Flowpath (km)	Average Slope (m/m)	Distance to Centroid (km)
A	9.369	7.335	0.0064	3.555
B1	23.709	12.290	0.0102	5.670
B2	30.700	22.768	0.0082	14.268
B3	14.210	3.320	0.0118	4.948
B4	5.516	3.821	0.0139	1.961
C1	23.466	9.812	0.0159	5.392
C2	43.774	19.208	0.0092	12.188
C3	12.919	9.356	0.0155	4.256
C4	4.300	2.740	0.0066	2.100
C5	11.649	6.520	0.0299	2.980
C6	4.080	2.700	0.0019	1.187

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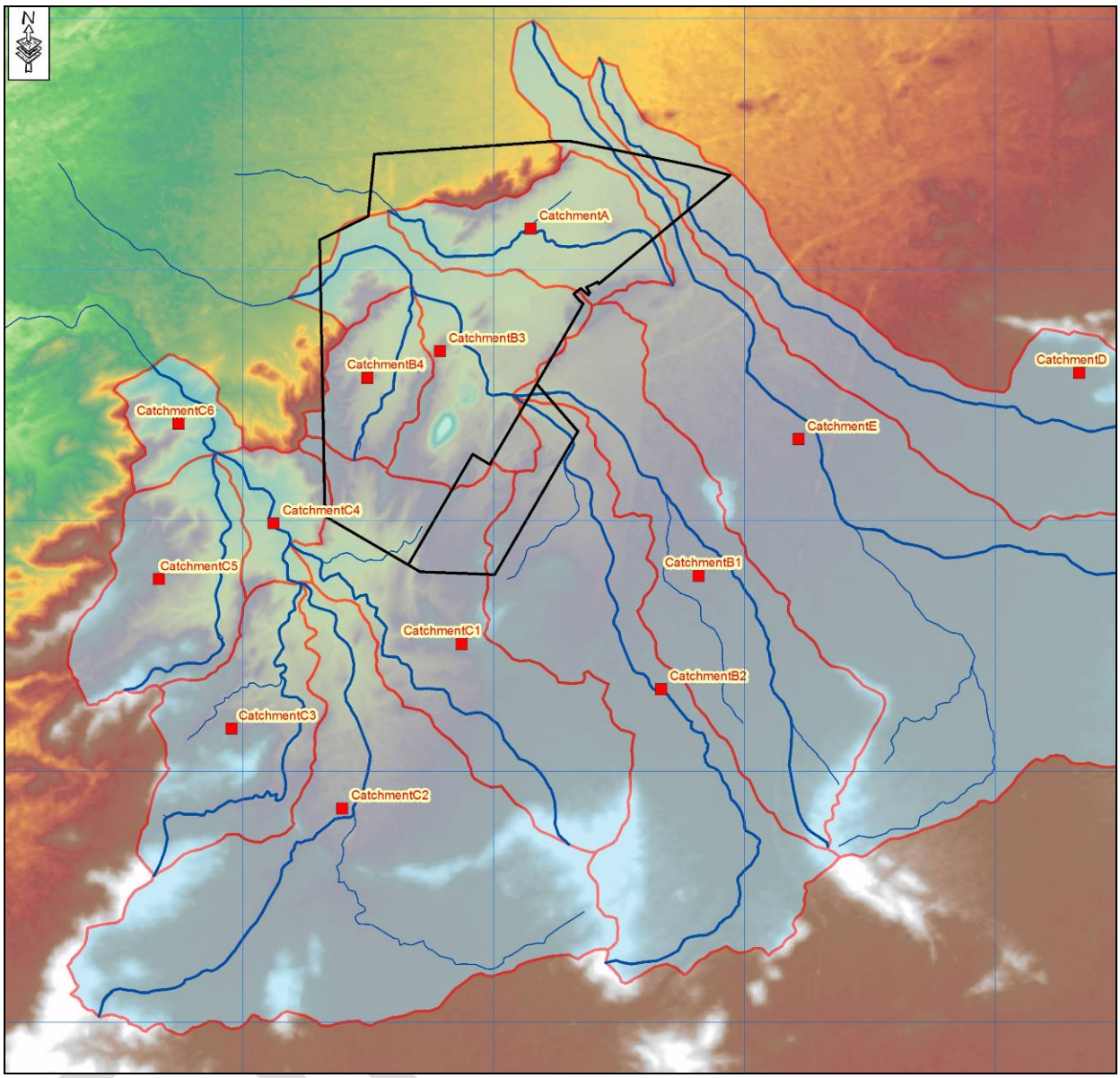

Figure 2.1 : Significant streams, tributaries and sub-catchment areas

2.2 Rainfall Information

It was very difficult to directly estimate the 1:50 and 1:100 year rainfall based on the limited rainfall data, received from the Client. Essentially we received 19 years of monthly rainfall records for the rainfall station located at the Navachab Mine.

Based on the monthly data, its clear that the majority of the rainfall falls between December and March but the data does not allow any insight into daily rainfall events, which are necessary in determining the 1:50 and 1:100 year 24hr point precipitation.

The rainfall data provided by the Client was substituted with the daily rainfall records obtained from a nearby station located 12 km form the project area in the town of Karibib.

The rainfall station 826596 at Karibib was chosen as the most reliable due to the length of its record (32 years). There is another rainfall station at Usakos, but it was not considered as it only has 28 years of record and is located further away from the site. The rainfall data for the chosen station is presented in Table 2.2 and Table 2.3.

Table 2.2 : Characteristics of Rainfall Station - 826596

Rainfall Station	Mean Annual Precipitation (mm)	Record (years)
826596	269	32

Table 2.3 : Design Rainfall for Station - 740154

Duration (Days)	Return Period (years)						
	2	**5**	**10**	**20**	**50**	**100**	**200**
1 day	32	49	63	78	102	123	146
2 days	40	60	74	91	116	139	170
3 days	42	68	89	114	153	189	234
7 days	50	83	111	142	195	245	308

63 mm,78 mm, 102 mm and 123 mm were used to determine the 1:10, 1:20, 1:50 and 1:100 year flood events respectively.

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3 FLOOD PEAK DETERMINATION

3.1 Rational Method

The Rational method uses the depth-duration-return period diagram to determine point precipitation in the catchment. The Rational method, primarily applied to small catchments (15 to 25 km^2), has been found to give good results for catchments up to 500 km^2.

The Rational method uses the following equation to determine the run-off from the catchment:

$$Q = \frac{C.I.A}{3.6} \qquad \text{Equation 1}$$

Where Q = Peak Flow (m^3/s)
C = runoff coefficient
I = Rainfall Intensity (mm/hr)
A = Catchment Area (km^2)

A runoff coefficient of 0.399 has been assumed for catchment area. The runoff coefficient is based on surface slopes, permeability and vegetation. The rainfall intensity (mm/hr) is the point precipitation (mm) divided by the time of concentration (hr).

The streams running through the project area are considered ephemeral and only tend to flow after spate rainfall events. The infrequent flows supports the use of the overland equation in determining the time of concentration.

$$T_c = 0.604\left(\frac{rL}{S^{0.5}}\right)^{0.467} \qquad \text{Equation 2}$$

Where T_c = Time of Concentration (hrs)
r = Roughness coefficient (0.25 – 0.30)
L = Longest Flowpath (km)
S = Average Catchment Slope (m/m)

Longest flowpath is the longest distance that water would follow from the furthest point in the catchment to the end of the flowpath.

The results of the flood hydrology determination is summarised in Table 3.1.

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Table 3.1 : Flood Peaks calculated using the Rational Method

Catchment Area	Flow Rate (m^3/s)			
	1:10 yr	1:20 yr	1:50 yr	1:100 yr
A	10.5	13.7	18.8	24.4
B1	23.7	31.0	42.3	54.6
B2	23.2	30.3	41.4	53.5
B3	23.8	31.1	42.5	54.9
B4	9.1	11.9	16.3	21.1
C1	27.8	36.3	49.6	63.9
C2	36.0	47.0	64.2	82.8
C3	15.6	20.4	27.9	36.1
C4	7.0	9.2	12.6	16.3
C5	18.2	23.7	32.5	42.0
C6	5.3	6.9	9.5	12.3

3.2 Alternative Rational Method

This method is an adaptation of the traditional Rational method shown Section 3.1.

The main difference lies in the method used to calculate the point precipitation. The Rational method uses the depth-duration-return period diagram to determine point precipitation, whilst the alternative method uses the modified recalibrated Hershfield equation for short durations (less than 6 hours) and actual design rainfall (Smithers and Schulze, 2001) for durations of 1 to 7 days (South African National Roads Agency, 2006). The results are shown in Table 3.2.

Table 3.2 : Flood Peaks calculated using the Alternative Rational Method

Catchment Area	Flow Rate (m^3/s)			
	1:10 yr	1:20 yr	1:50 yr	1:100 yr
A	15.6	20.4	27.0	32.8
B1	35.6	46.6	61.5	74.6
B2	35.1	45.9	60.7	73.6
B3	35.3	46.1	60.9	73.9
B4	13.4	17.5	23.2	28.1
C1	41.4	54.2	71.7	86.9
C2	53.6	70.1	92.7	112.4
C3	23.2	30.3	40.1	48.6
C4	10.3	13.5	17.8	21.6
C5	26.8	35.1	46.4	56.3
C6	7.8	10.2	13.5	16.4

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3.3 Unit Hydrograph Method

A unit hydrograph is a characteristic of a specific catchment and is defined as the hydrograph of 1mm of runoff (excess rain), following rainfall of unit duration, with uniform spatial and time distribution over the catchment. Hence the duration of the hydrograph is proportional to the duration of the rainfall and the volume proportional to the intensity of the rainfall (Van der Spuy et al, 2004).

Unit hydrographs from numerous flow gauging stations in South Africa were compiled from historical data. From this data, synthetic hydrographs for 9 regions of South Africa have been derived. These 9 regions have similar catchment characteristics such as topography, soil type, vegetation type and rainfall characteristics. The catchment in question belongs to veld type zone 4.

The Synthetic Unit Hydrograph (SUH) method is applicable to catchments of sizerange15km^2 – 5000km^2. The SUH method as implemented in UPD was used to determine the flood peak discharge for the same range of return periods. The results are summarised in Table 3.3.

Table 3.3 : Flood Peaks calculated using the SUH Method

Catchment Area	Flow Rate (m^3/s)			
	1:10 yr	1:20 yr	1:50 yr	1:100 yr
A	15.7	22.2	33.8	47.0
B1	30.2	42.5	64.4	88.9
B2	29.8	41.8	63.6	87.5
B3	27.4	38.8	59.1	82.0
B4	11.2	15.9	24.3	33.8
C1	35.3	49.6	75.2	103.8
C2	46.9	65.7	99.2	136.5
C3	21.6	30.6	46.5	64.6
C4	8.7	12.4	19.0	26.4
C5	23.2	32.8	50.1	69.7
C6	8.3	11.8	18.0	25.1

3.4 Empirical Flood Peak Estimate

The Regional Maximum Flood (RMF) (Kovacs, 1988) approach was developed for Southern Africa in the late 1980's and with time has proved to produce good estimates of flood peak discharges.

Kovacs (1988) adopted the methodology by Francou and Rodier (Hydrological Services of Electricité de France) for Southern African conditions.

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The Francou Rodier Formula is given as:

$$\frac{Q}{Q_0} = \left(\frac{A}{A_0}\right)^{1-0.1x} \qquad \text{Equation 3}$$

Where: Q = Required Flood Peak (m^3/s)
Qo = Mean Annual Runoff of all the rivers in the world (10^6 m^3/s)
A = Catchment area (km^2)
A_o = Total drainage area on earth ($10^8 km^2$) (excl deserts and polar regions)
K = Regional characteristic coefficient

Kovacs based the K values for Southern Africa on maximum flood peaks recorded at various sites in South Africa and neighbouring countries. Eight maximum flood peak regions were identified based on rainfall, catchment characteristics and recorded flood peaks. The RMF is calculated using the Francou-Rodier formula on the basis of the catchment area and a regional K factor. For the project area, the applicable K factor is 4.0. Table 3.4 gives scaled RMF flood peak values.

Table 3.4 : Flood Peaks calculated using the RMF Method

Catchment Area	Flow Rate (m^3/s)			
	1:10 yr	1:20 yr	1:50 yr	1:100 yr
A	12.8	17.4	24.1	30.5
B1	23.1	31.4	43.5	55.2
B2	20.5	27.8	38.5	48.8
B3	20.8	28.3	39.1	49.7
B4	11.6	15.8	21.8	27.7
C1	25.3	34.4	47.7	60.5
C2	29.3	39.8	55.2	70.1
C3	16.6	22.5	31.2	39.6
C4	9.3	12.6	17.5	22.2
C5	18.8	25.6	35.4	45.0
C6	8.8	12.0	16.6	21.1

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4 FLOOD ASSESSMENT

The flood peaks determined using the Rational, Alternative Rational, Synthetic Unit Hydrograph (SUH) and RMF methods are summarised in Table 4.1 and Table 4.2.

Table 4.1 : 1:50 year Flood Peak Summary

Catchment	Flood Peak (m^3/s)				
	Rational	Alt Rational	SUH	RMF	Recommended
A	18.8	27.0	33.8	24.1	**30.40**
B1	42.3	61.5	64.4	43.5	**62.95**
B2	41.1	60.7	63.3	38.5	**62.00**
B3	42.5	60.9	59.1	39.1	**60.00**
B4	16.3	23.2	24.3	21.8	**23.75**
C1	49.6	71.7	75.2	47.7	**73.45**
C2	64.2	92.7	99.2	55.2	**95.95**
C3	27.9	40.1	46.5	31.2	**43.30**
C4	12.6	17.8	19.0	17.5	**18.40**
C5	32.5	46.4	50.1	35.4	**48.25**
C6	9.5	13.5	18.0	16.6	**15.75**

Table 4.2 : 1:100 year Flood Peak Summary

Catchment	Flood Peak (m^3/s)				
	Rational	Alt Rational	SUH	RMF	Recommended
A	24.4	32.8	47.0	30.5	**39.90**
B1	54.6	74.6	88.9	55.2	**81.75**
B2	53.5	73.6	87.5	48.8	**80.55**
B3	54.9	73.9	82.0	49.7	**77.95**
B4	21.1	28.1	33.8	27.7	**30.95**
C1	63.9	86.9	103.8	60.5	**95.35**
C2	82.8	112.4	136.5	70.1	**124.45**
C3	36.1	48.6	64.6	39.6	**56.60**
C4	16.3	21.6	26.4	22.2	**24.00**
C5	42.0	56.3	69.7	45.0	**63.00**
C6	12.3	16.4	25.1	21.1	**20.75**

The RMF is an empirical method and the flood peak is based on regional information. This method is useful for evaluating results obtained using more rigorous methods or where data is not sufficient to use the more rigorous methods. The RMF is noted for producing less

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conservative estimates for smaller catchments and is therefore not representative for small catchments (<30km^2).

Generally, SUH results are higher than the equivalent Rational results for smaller catchments. The SUH is usually applied to medium to large catchments (>15km^2) and is therefore only suitable for certain catchments. The Rational methods are more applicable to smaller catchment sizes and produce conservative results.

The Alternative Rational method is based on rainfall data applicable to the project area and is favoured over the Rational method. It is suggested that the average value of the Alternative Rational method and the SUH method be adopted for the 1:50 and 1:100 year design floods for all the catchments areas. less than 15km^2 and the average value of the be adopted for catchment areas greater than 15km^2; namely catchments B1, B2, C1 and C2. This is considered a reasonable approach providing suitably conservative results.

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5 FLOOD INUNDATION LINES

The 1:50 year and 1:100 year flood inundation lines were prepared using the HEC-RAS software. The primary input to HEC-RAS is the cross section information that describes the shape and slope of the stream, and the channel roughness. The HEC-RAS cross section plans are presented in **Appendix D**.

Cross sections were prepared from the LiDAR survey of the area using the HEC-GEORAS interface. Three sets of survey data were used to develop a surface containing the project area and the contributing catchment area. The combined survey mapping is presented in A**ppendix B**.

The channel roughness coefficient, required by the HEC-RAS software was estimated at 0.035. HEC-RAS is a backwater programme based on the Mannings' equation. The programme determines the flow depth and velocities at the cross-sections. The results obtained from HEC-RAS, for the seven stream sections are summarised in **Appendix E**.

The analysis results were then exported to ArcView, which was used to prepare the flood inundation maps of the project area. The 1:50 and 1:100 year floodlines are presented in **Appendix C**.

The flood inundations areas for the 1:50 year and 1:100 year floods are not significantly different. The wide stream channel and defined banks results in a very small rise in the water level. This results in a very small increase in the inundation areas between the two flood events.

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6 POTENTIAL MITIGATION MEASURES

The floodline assessment has indentified that significant areas of the project area lie within the 1:50 and 1:100 year flood inundations areas, as presented in **Appendix C**. Flood mitigation involves managing the effects of this flooding, rather than trying to prevent it altogether.
The purpose of this investigation was to determine the extent of the possible flooding, and then propose alternatives to alleviate the impact of potential flooding.

Stream diversion, culverts, stormwater pipes, diversion berms and attenuation dams are some of the planning controls that can be used to assist with flood protection for developments within the flood inundation area. All flood attenuation facilities should be designed to provide control for a 1:50 and/or 1:100 year flood.

Unlined trapezoidal diversion canals, running along the perimeter of the plant and pits, can be designed to contain the 1:50 year floods and thereby eliminate flooding. Diversion berms are another alternative to containing flood waters. These approaches can be developed at Navachab mine to reduce the impact of flooding.

6.1 Diversion Canals

Simple unlined trapezoidal diversion canals can be constructed around the existing plant and pits. The canals will divert the flow around the site and then discharge back into the natural channel.

The hydraulic design of the unlined trapezoidal diversion canals will ensure that the canal operates under stable, sub-critical flow conditions where possible. The stable, sub-critical flow conditions will limit erosion of the canal. To achieve this, Froude numbers of less than 0.7 are necessary.

Canal A (red line) runs around the northern pit and tailings dam as shown in Figure 6.1. Canal B1 (green line) runs north around the plant and the Canal B2 (green line) runs south around the pit. Both canals will divert the runoff from catchments B1 to B4 around the plant and pit before returning to the original river alignment as shown in Figure 6.2.

An additional canal may be constructed along the alignment of Stream C. The canal will sized to accommodate the entire runoff from catchments C1 to C6, thus resulting in no floodlines. This canal should be developed in accordance with the future development of the mine.

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Figure 6.1 : Proposed Canal A alignment

Figure 6.2 : Proposed Canal B1 and B2 alignments

The design parameters of the prposed unlined trapezoidal canals are as follows:

- Unlined trapezoidal drains with 1V: 3H side slopes;
- Unlined drain Mannings' n = 0.030;
- Drain slopes = 1 : 200; and
- Drain depth = flow depth + 10% allowance for groundwater + 300mm freeboard (Sub-critical flow conditions).

Flow depth was calculated using the Mannings' equation:

$$Q = \frac{AR^{2/3}S^{1/2}}{n}$$ Equation 3

Where Q = Peak Flow (m^3/s)
A = Cross Section Flow Area (m^2)
R = Hydraulic Radius (m)
S = Canal Slope (m/m)
n = Mannings' n value (0.030)

The above equation was manipulated to solve for flow depth. Preliminary canal sizes were calculated for the canals associated with streams A and B. The results are presented in **Table 6.1** and **Table 6.2**.

Table 6.1 : Diversion Canal sizes for the 1:50 yr flood events

Canal Sections	Flowrate	Base Width	Flow Depth	Flow Velocity	Total Depth	Top Width
	m^3/s	m	m	m/s	m	m
Canal A	30.00	5.00	2.196	2.415	2.715	6.464
Canal B1	65.00	10.00	2.187	2.770	2.705	11.458
Canal B2	68.00	10.00	2.251	2.811	2.776	11.500

Table 6.2 : Diversion Canal sizes for the 1:100 yr flood events

Canal Sections	Flowrate	Base Width	Flow Depth	Flow Velocity	Total Depth	Top Width
	m^3/s	m	m	m/s	m	m
Canal A	40.00	5.00	2.614	2.600	3.175	6.742
Canal B1	85.00	10.00	2.595	3.014	3.155	11.730
Canal B2	88.00	10.00	2.653	3.047	3.219	11.769

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6.2 Diversion Culvert

Alternatively, a single canal (orange line) can be developed for Stream B, following the original stream alignment, incorporating a diversion culvert. This will allow the canal to pass between the plant and the pit. The proposed alignment is illustrated in Figure 6.3.

Figure 6.3 : Proposed canal and culvert alignment for Stream B

Using the same design approach adopted in Section 6.1, the hydraulic results for the single canal B incorporating a diversion culvert is presented in Table 6.3.

Table 6.3 : Diversion Canal B sizes for the 1:50 and 1:100 yr flood events

Flood Event	Flowrate	Base Width	Flow Depth	Flow Velocity	Total Depth	Top Width
	m^3/s	m	m	m/s	m	m
1:50 yr	133.000	15.00	2.601	3.223	3.161	16.734
1:100 yr	173.000	15.00	3.073	3.513	3.681	17.049

7 CONCLUSIONS AND RECOMMENDATIONS

The flood inundation areas for the 1:50 and 1:100 year flood events are not significantly different. This is due to the nature of the stream channel. The cross sections indicate a wide channel with clearly defined banks on either side. The water levels for the 1:50 and 1:100 year flood events rise by a small amount, which is contained within the stream channel. This results in very little change in the inundation areas.

It is clearly evident from the floodline mapping (see **Appendix C**) that the existing mining infrasturcutre is located within the flood inundation areas. This poses a significant risk to both the infrastructure as well as the downstream envirionment.

In order to minimise the impact of the flooding, mitigation measures were proposed. The mitigation measures included the development of adequately sized diversion canals thoughout the project area. The proposed diversion canals have been sized to safely contain the 1:50 and 1:100 year flood events. By developing the diversion canals, the flood runoff is channelled through the project area in a contained and controlled manner. The diversion strategy has been developed to manage the flow of stormwater through the site.

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APPENDICES

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APPENDIX A:
CATCHMENT AREAS OF THE SIGNIFICANT STREAMS IN PROJECT AREA

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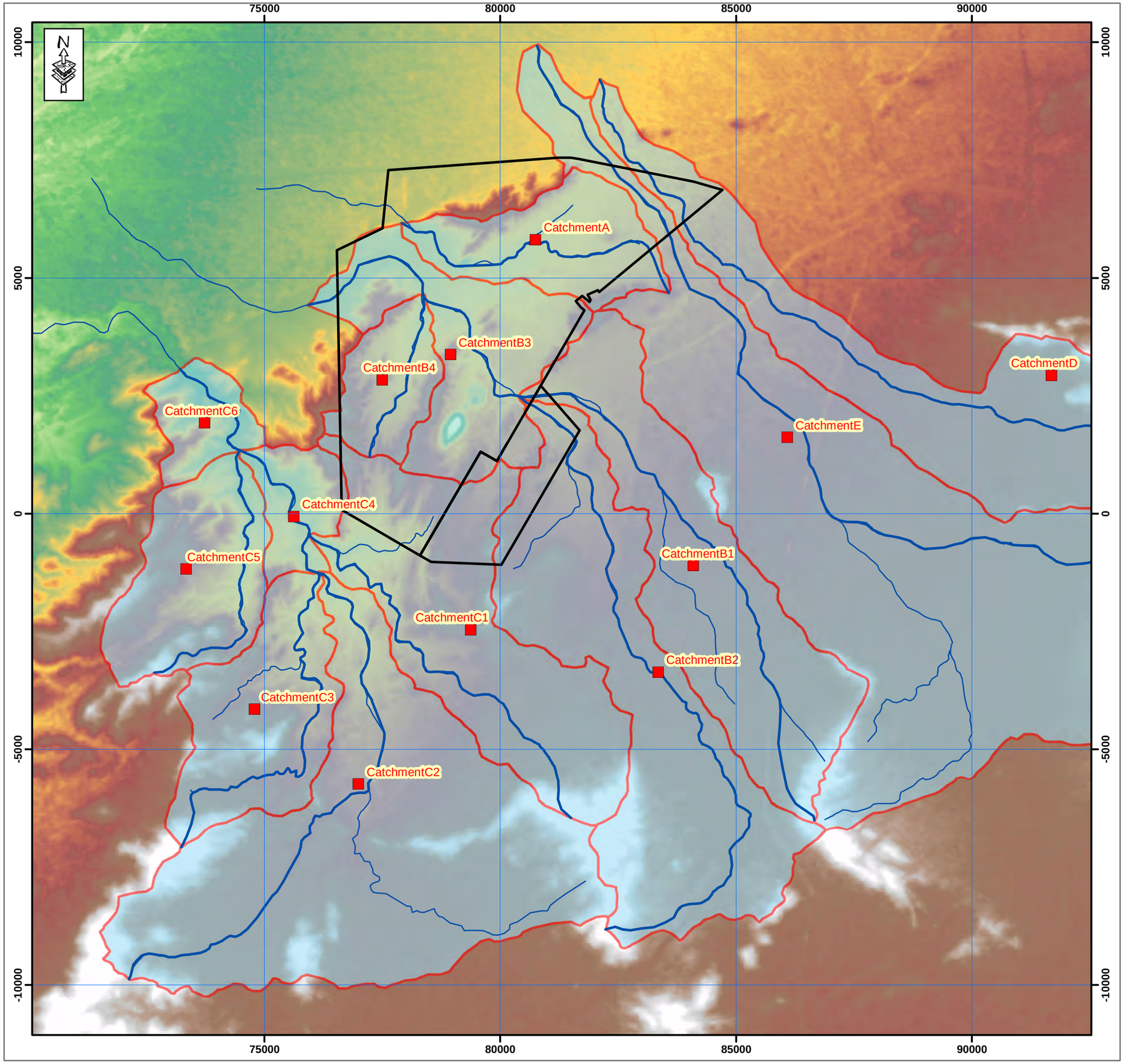

Legend

- Catchment Centroids
- Mining Licence
- Drainage
- Flowpaths
- Catchments

Topography (m)

Value

High : 1890

Low : 769

Projection: Namibian: LO22-15

0 625 1 250 2 500 3 750 5 000 Meters

NAVACHAB EXPANSION STUDY

FIGURE 1:Catchment Areas and Flowpaths

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303-00417/02	July 2012

APPENDIX B:
COMBINED SURVEY MAPPING

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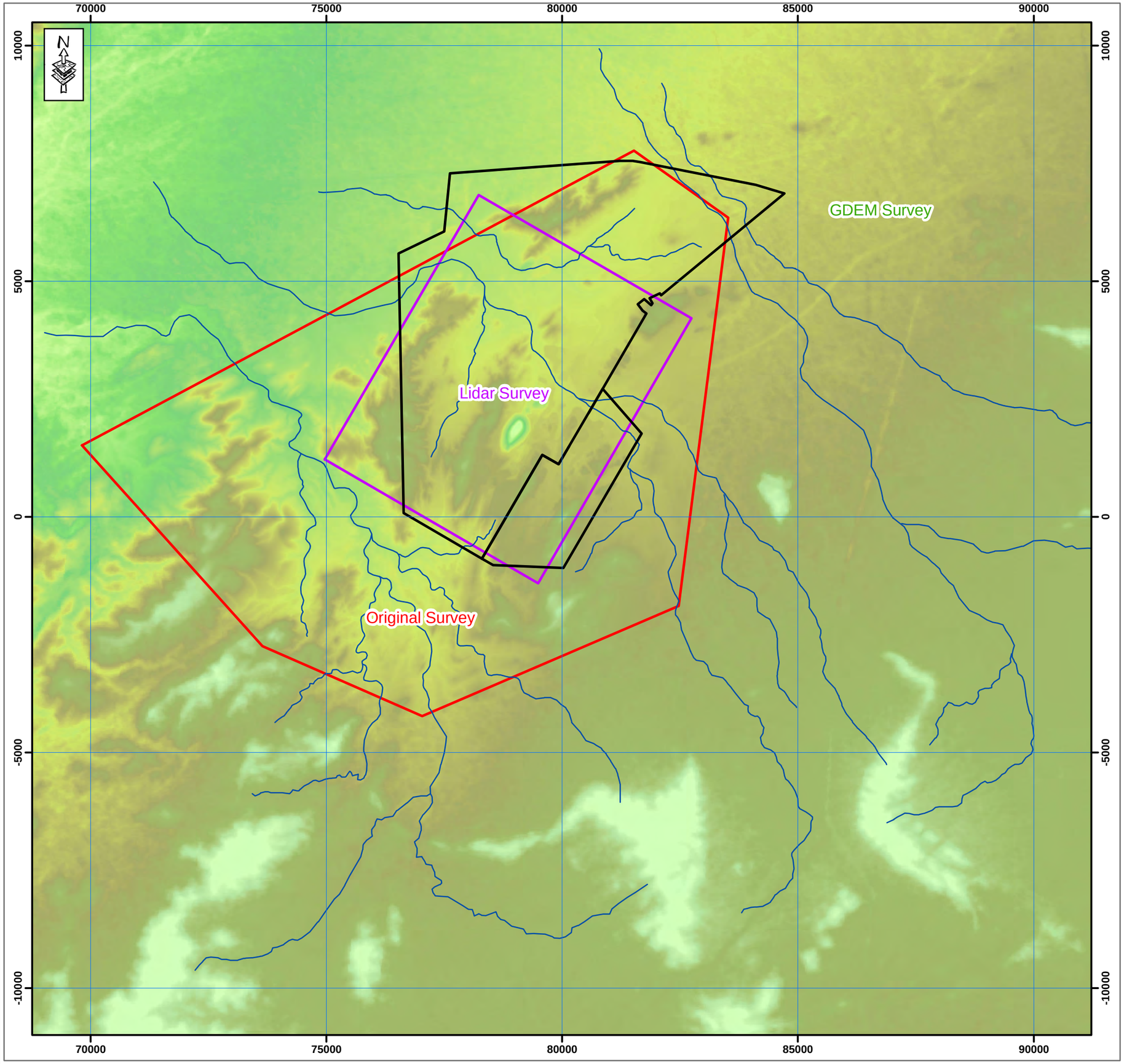

Legend

- Mining Licence
- Drainage
- Extent - Lidar Survey
- Extent - Original Survey
- GDEM Data

Topography (m)

Value

High : 1890

Low : 769

Projection: Namibian: LO22-15

0 625 1 250 2 500 3 750 5 000 Meters

NAVACHAB EXPANSION STUDY

FIGURE 2: Survey Extents

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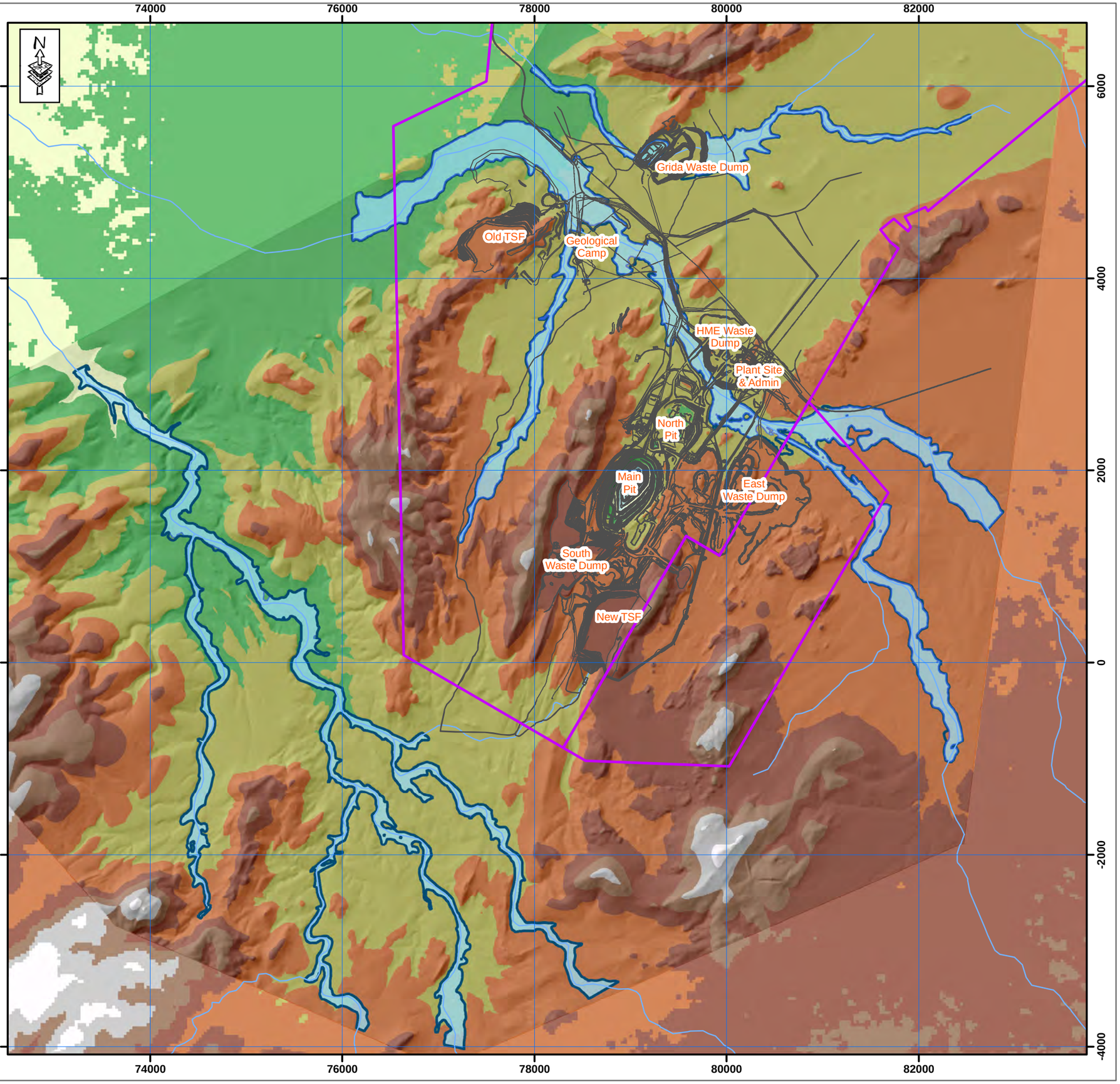
APPENDIX C:
1:50 AND 1:100 YR FLOOD INUNDATION MAPPING

DRAFT



Legend

- Mining Licence
- Navachab Infrastructure
- Drainage
- 50yr Floodlines
- 100yr Floodlines

Topography (m)

- Below 1000
- 1 000 - 1 050
- 1 050 - 1 100
- 1 100 - 1 150
- 1 150 - 1 200
- 1 200 - 1 250
- 1 250 - 1 300
- 1 300 - 1 350
- 1 350 - 1 400

Projection: Namibian: LO22-15

0 375 750 1 500 2 250 3 000 Meters

NAVACHAB EXPANSION STUDY

FIGURE 6: All Floodlines

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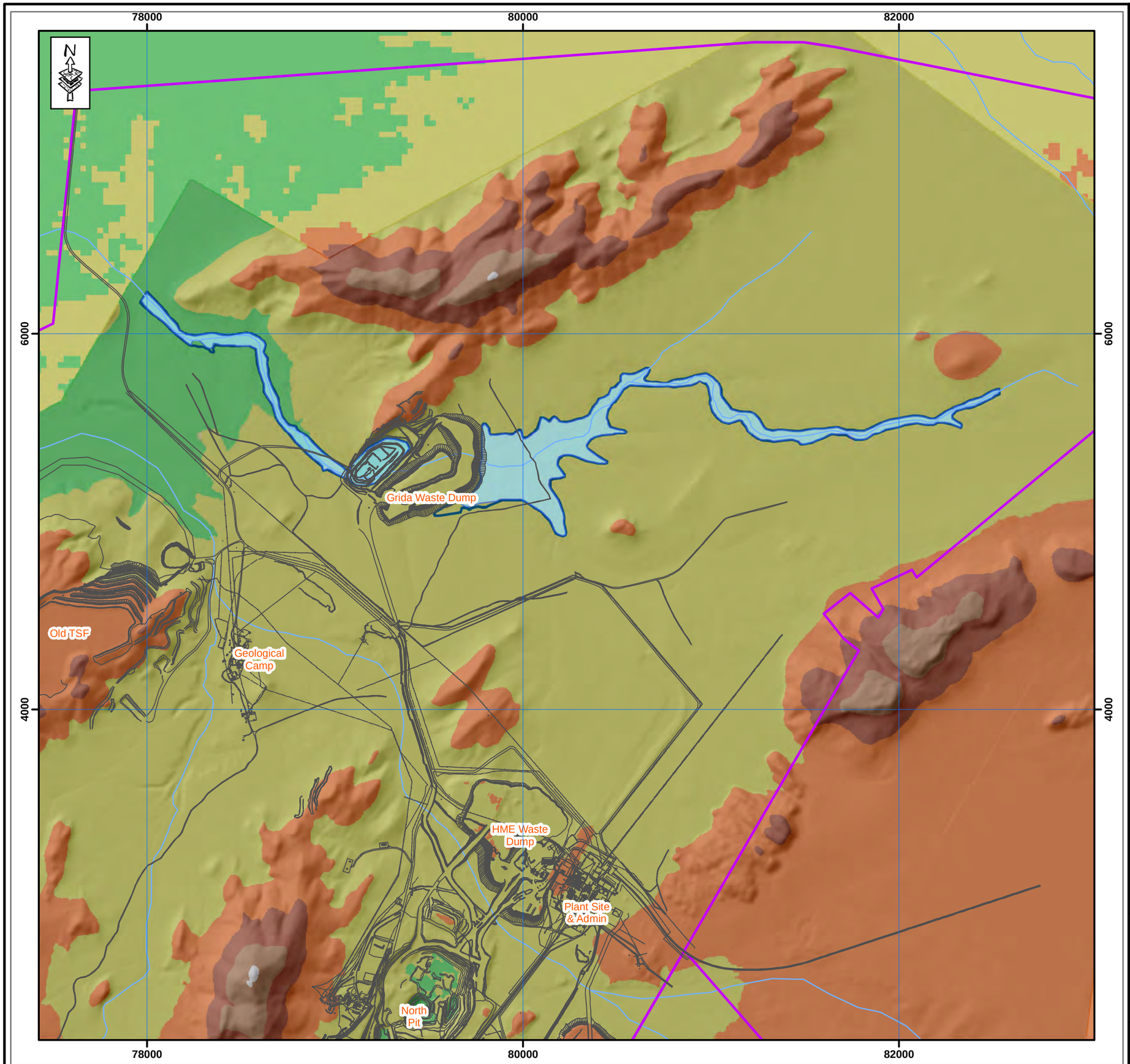

Legend

- Navachab Infrastructure
- Mining Licence
- Drainage
- 50yr Floodlines
- 100yr Floodlines

Topography (m)

- Below 1000
- 1 000 - 1 050
- 1 050 - 1 100
- 1 100 - 1 150
- 1 150 - 1 200
- 1 200 - 1 250
- 1 250 - 1 300
- 1 300 - 1 350
- 1 350 - 1 400

Projection: Namibian: LO22-15

0 187.5 375 750 1 125 1 500 Meters

NAVACHAB EXPANSION STUDY

FIGURE 3: Floodlines
Catchment A

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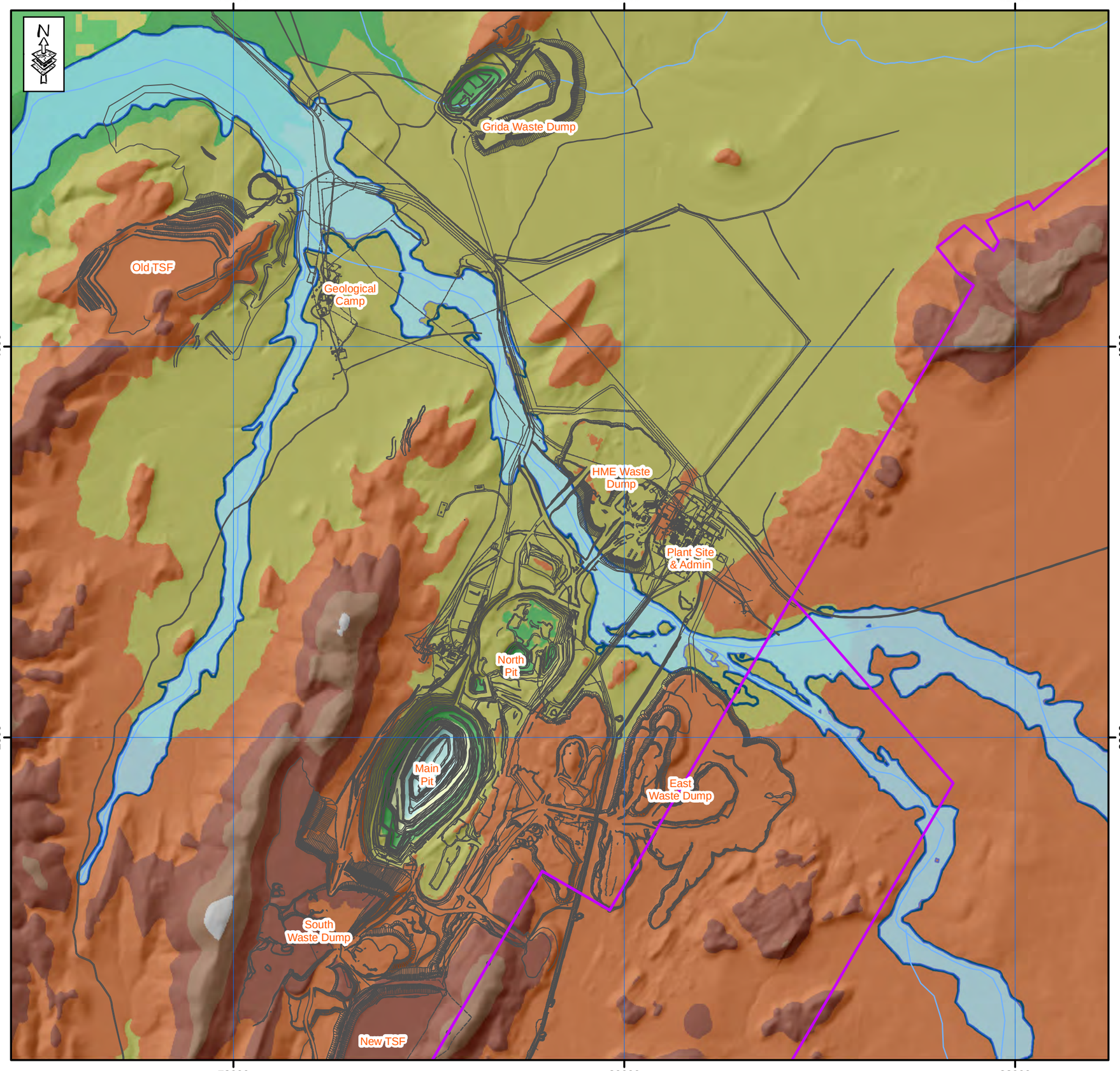

Legend

- Mining Licence
- Navachab Infrastructure
- Drainage
- 50yr Floodlines
- 100yr Floodlines

Topography (m)

- Below 1000
- 1 000 - 1 050
- 1 050 - 1 100
- 1 100 - 1 150
- 1 150 - 1 200
- 1 200 - 1 250
- 1 250 - 1 300
- 1 300 - 1 350
- 1 350 - 1 400

Projection: Namibian: LO22-15

0 187.5 375 750 1 125 1 500 Meters

NAVACHAB EXPANSION STUDY

FIGURE 4: Floodlines
Catchment B

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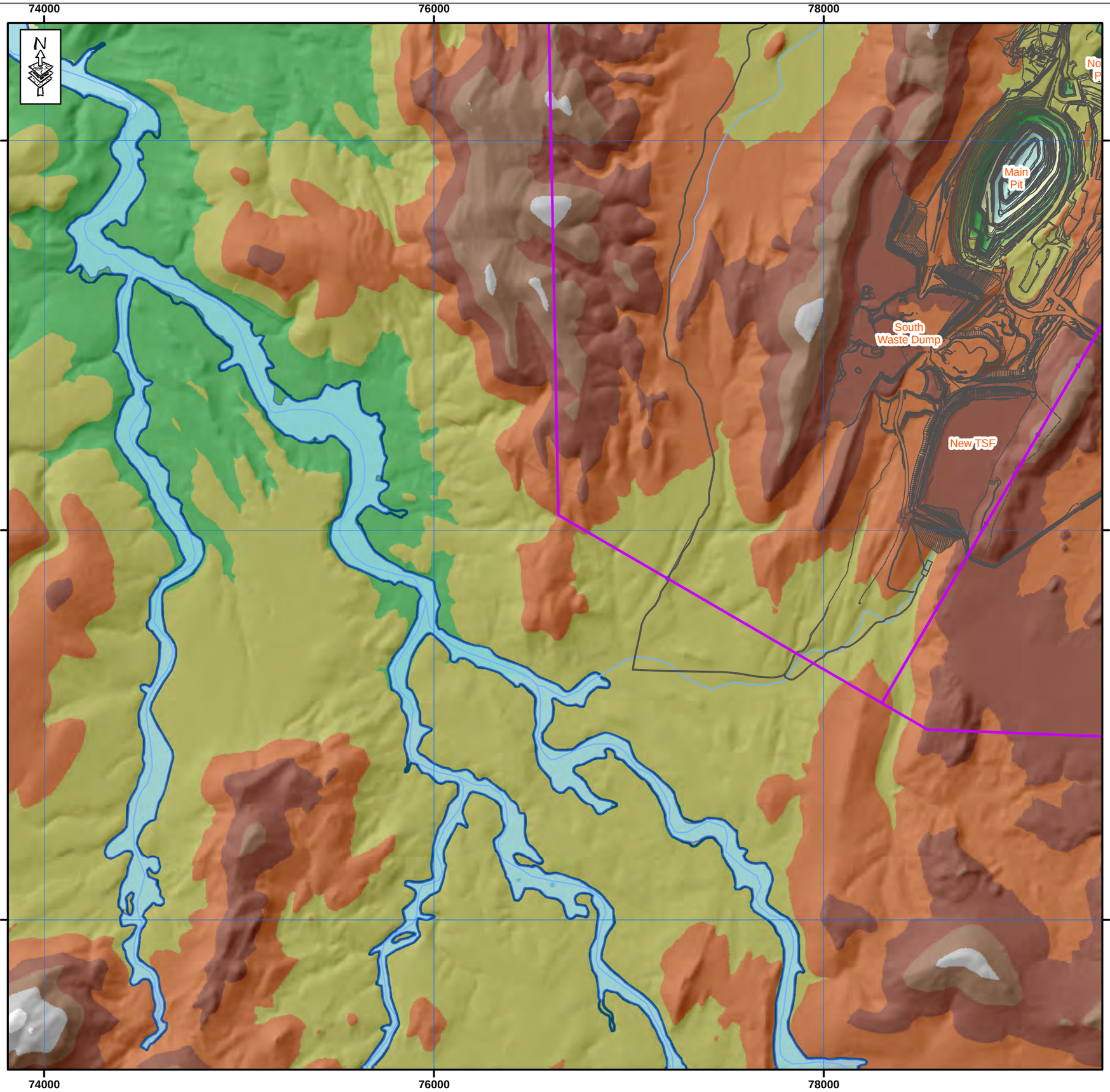

Legend

- Mining Licence
- Navachab Infrastructure
- Drainage
- 50yr Floodlines
- 100yr Floodlines

Topography (m)

- Below 1000
- 1 000 - 1 050
- 1 050 - 1 100
- 1 100 - 1 150
- 1 150 - 1 200
- 1 200 - 1 250
- 1 250 - 1 300
- 1 300 - 1 350
- 1 350 - 1 400

Projection: Namibian: LO22-15

0 187.5 375 750 1 125 1 500 Meters

NAVACHAB EXPANSION STUDY

FIGURE 5: Floodlines
Catchment C

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CONSULTING

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APPENDIX D:
HEC-RAS CROSS SECTION PLANS

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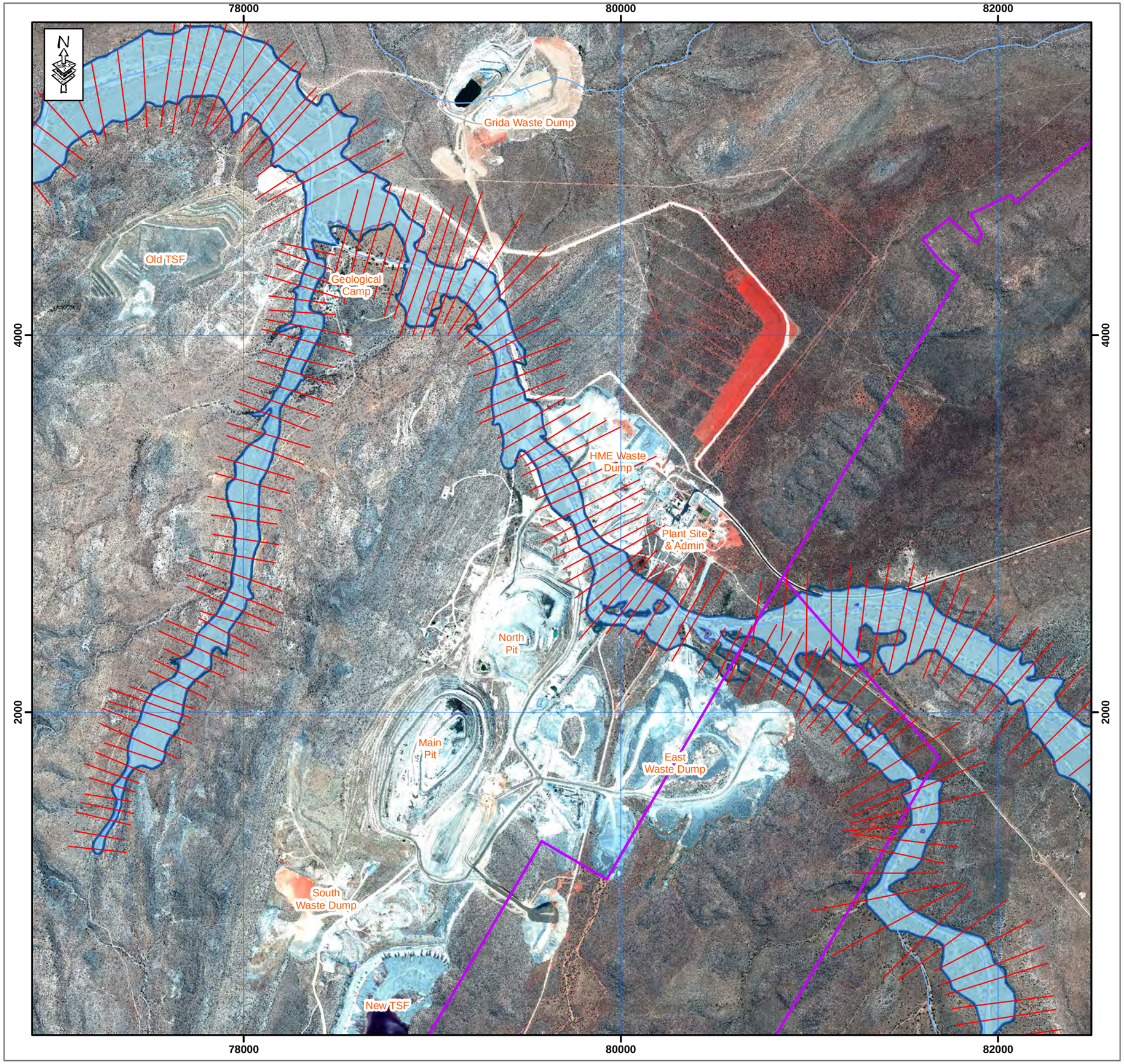

Legend

- Hecras Cross-sections
- Mining Licence
- Drainage
- 50yr Floodlines
- 100yr Floodlines

Projection: Namibian: LO22-15

0 187.5 375 750 1 125 1 500 Meters

NAVACHAB EXPANSION STUDY

FIGURE 8: Floodlines Details - Catchment B

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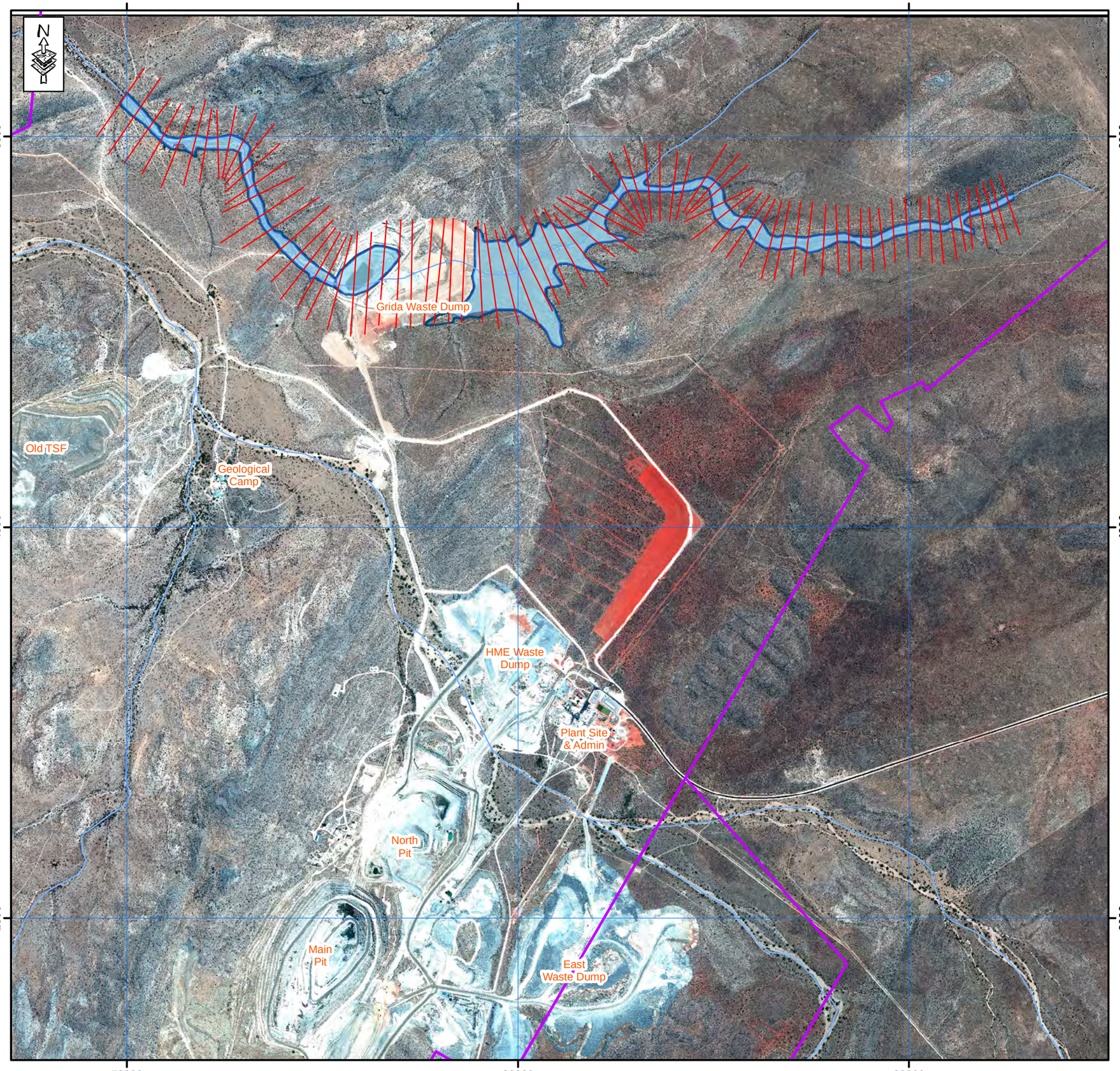
303-00417/02	July 2012



Legend

- Hecras Cross-sections
- Mining Licence
- Drainage
- 50yr Floodlines
- 100yr Floodlines

Projection: Namibian: LO22-15

0 187.5 375 750 1 125 1 500 Meters

NAVACHAB EXPANSION STUDY

FIGURE 7: Floodlines
Details - Catchment A

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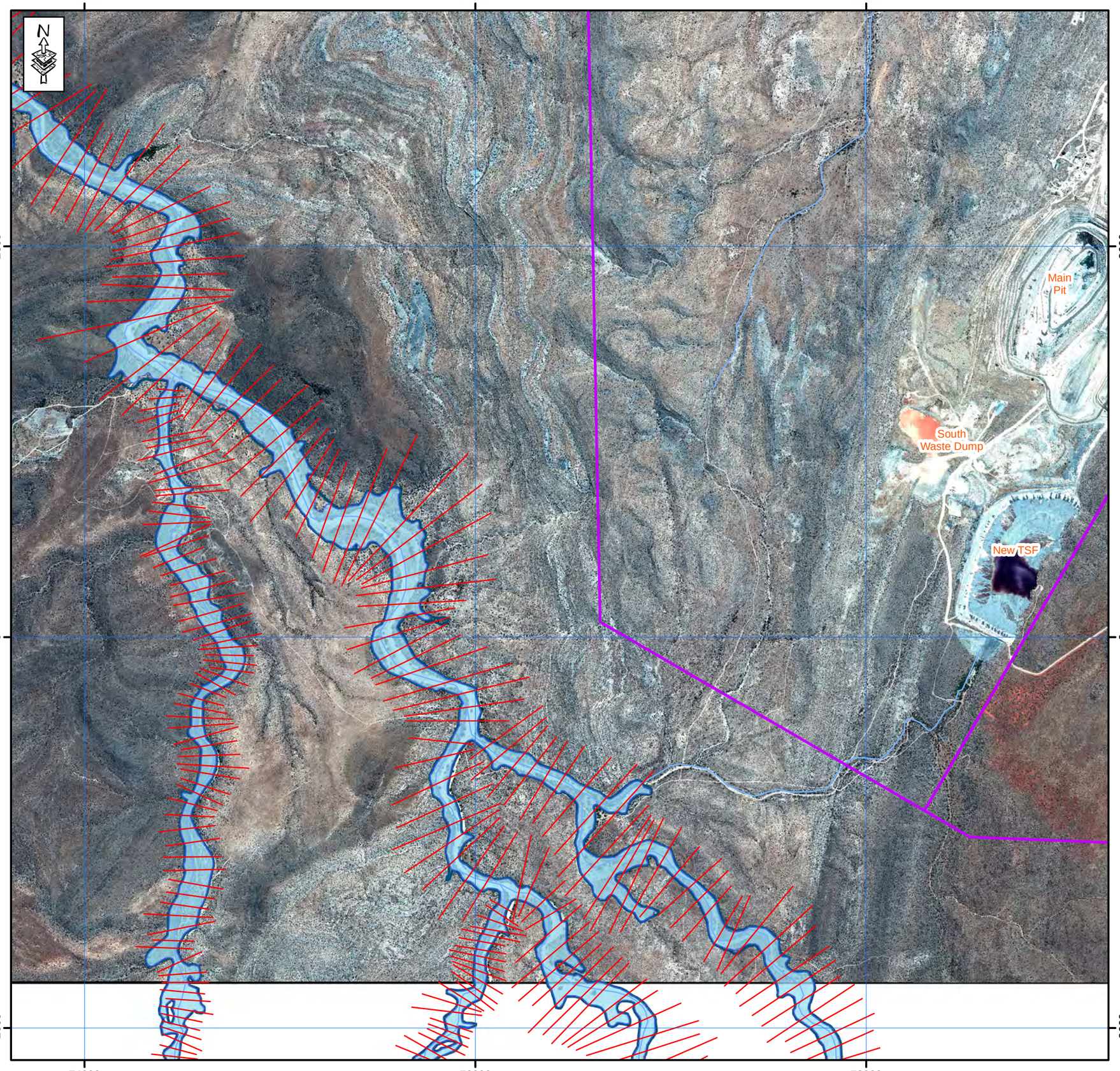
303-00417/02	July 2012



Legend

- Hecras Cross-sections
- Mining Licence
- Drainage
- 50yr Floodlines
- 100yr Floodlines

Projection: Namibian: LO22-15

0 187.5 375 750 1 125 1 500 Meters

NAVACHAB EXPANSION STUDY

FIGURE 9: Floodlines Details - Catchment C

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APPENDIX E:
HEC-RAS OUTPUT FILES

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Table E1 : HEC-RAS Output file for Stream A (1:50 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
5683.375	30.400	0.700	2.090	1136.300	0.923	33.020
5622.780	30.400	1.090	1.500	1135.070	1.205	28.390
5583.000	30.400	0.970	1.470	1134.890	1.080	31.830
5530.866	30.400	0.610	1.750	1134.450	0.766	56.560
5473.416	30.400	0.650	2.590	1133.010	0.992	34.940
5417.573	30.400	0.850	0.750	1132.720	0.879	67.750
5366.495	30.400	0.590	2.000	1132.530	0.794	37.960
5302.298	30.400	1.120	1.440	1131.230	1.226	29.780
5249.999	30.400	1.160	1.170	1131.060	1.230	34.200
5196.291	30.400	0.890	1.330	1130.890	0.980	37.020
5126.542	30.400	0.880	1.130	1130.630	0.945	45.200
5055.287	30.400	0.560	1.890	1130.190	0.742	45.140
4991.123	30.400	1.000	1.230	1128.960	1.077	36.950
4927.485	30.400	0.890	1.140	1128.760	0.956	45.810
4872.023	30.400	0.530	1.850	1128.390	0.704	48.400
4806.596	30.400	1.090	1.280	1127.260	1.174	34.900
4746.008	30.400	0.860	1.540	1126.980	0.981	35.940
4673.393	30.400	0.710	1.000	1126.640	0.761	60.930
4589.861	30.400	0.480	1.700	1126.110	0.627	61.210
4527.998	30.400	0.820	1.250	1124.840	0.900	44.640
4456.484	30.400	0.520	1.290	1124.420	0.605	67.040
4401.417	30.400	0.470	1.720	1123.760	0.621	59.810
4315.002	30.400	0.600	0.900	1122.640	0.641	86.820
4251.317	30.400	0.430	1.620	1122.190	0.564	72.260
4165.555	30.400	0.650	0.710	1120.640	0.676	82.320
4069.945	30.400	0.740	0.800	1120.470	0.773	81.510
4009.968	30.400	0.480	1.730	1120.170	0.633	57.780
3940.564	30.400	0.840	0.900	1118.860	0.881	56.210
3896.197	30.400	0.670	1.440	1118.710	0.776	48.350
3840.973	30.400	0.540	1.760	1118.080	0.698	56.000
3728.794	30.400	0.920	1.380	1116.850	1.017	35.770
3677.115	30.400	0.620	2.050	1116.440	0.834	35.080
3608.366	30.400	1.210	1.550	1115.260	1.332	25.580
3549.750	30.400	0.950	1.400	1114.940	1.050	48.120
3486.635	30.400	0.960	0.660	1114.800	0.982	66.560
3428.311	30.400	0.880	0.610	1114.750	0.899	70.080
3352.924	30.400	0.530	1.900	1114.580	0.714	44.620
3279.829	30.400	1.580	0.650	1114.050	1.602	56.870
3222.093	30.400	2.090	0.330	1114.030	2.096	69.150
3169.197	30.400	3.400	0.170	1114.030	3.401	151.270
3102.216	30.400	3.900	0.110	1114.030	3.901	135.620
3017.947	30.400	4.550	0.080	1114.020	4.550	237.140
2955.187	30.400	4.870	0.060	1114.020	4.870	222.140
2883.274	30.400	5.600	0.060	1114.020	5.600	214.150
2809.471	30.400	6.030	0.040	1114.020	6.030	271.210
2747.531	30.400	6.420	0.040	1114.020	6.420	370.480

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
2680.139	30.400	6.860	0.020	1114.020	6.860	432.330
2613.466	30.400	7.090	0.020	1114.020	7.090	348.730
2538.669	30.400	7.950	0.020	1114.020	7.950	341.610
2477.451	30.400	7.880	0.020	1114.020	7.880	418.380
2389.032	30.400	0.630	1.710	1114.010	0.779	61.500
2317.392	30.400	0.790	1.300	1112.730	0.876	41.680
2261.591	30.400	1.210	0.670	1112.620	1.233	59.610
2200.218	30.400	1.040	2.460	1112.460	1.348	20.500
2101.242	30.400	0.590	3.580	1109.880	1.243	22.240
2029.967	30.400	0.600	6.920	1102.830	3.041	10.810
1944.020	30.400	24.410	0.010	1101.210	24.410	160.850
1871.683	30.400	31.260	0.010	1101.210	31.260	211.240
1799.654	30.400	31.650	0.010	1101.210	31.650	189.090
1725.811	30.400	10.250	0.050	1101.210	10.250	101.970
1653.732	30.400	0.600	1.550	1101.200	0.722	50.400
1598.329	30.400	0.620	1.390	1100.710	0.718	51.890
1530.831	30.400	0.850	1.150	1100.310	0.917	57.570
1458.496	30.400	0.690	1.490	1099.840	0.803	52.630
1375.408	30.400	0.770	1.360	1099.160	0.864	52.670
1261.649	30.400	0.980	1.800	1098.320	1.145	27.170
1170.844	30.400	0.960	1.840	1097.580	1.133	29.670
1067.171	30.400	1.050	1.260	1096.920	1.131	44.330
1012.672	30.400	0.820	2.150	1096.490	1.056	30.380
939.571	30.400	0.840	1.200	1095.830	0.913	54.930
868.558	30.400	0.560	1.860	1095.230	0.736	47.280
793.093	30.400	0.810	1.250	1094.340	0.890	50.440
727.987	30.400	0.730	1.440	1093.850	0.836	69.150
674.135	30.400	0.610	1.710	1093.120	0.759	51.250
607.964	30.400	0.770	1.460	1092.370	0.879	52.280
540.102	30.400	1.020	1.030	1091.920	1.074	78.820
458.236	30.400	1.070	1.720	1091.410	1.221	31.200
366.765	30.400	0.960	1.800	1090.690	1.125	28.870
277.688	30.400	0.830	1.830	1089.880	1.001	32.410
180.728	30.400	1.040	1.300	1089.120	1.126	51.740
82.541	30.400	0.970	1.370	1088.510	1.066	47.850

Table E2 : HEC-RAS Output file for Stream A (1:100 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
5683.375	39.900	0.790	2.240	1136.430	1.046	35.700
5622.780	39.900	1.210	1.680	1135.220	1.354	30.140
5583.000	39.900	1.060	1.680	1135.020	1.204	33.510
5530.866	39.900	0.670	1.870	1134.540	0.848	61.980
5473.416	39.900	0.720	2.780	1133.140	1.114	37.880
5417.573	39.900	0.960	0.820	1132.830	0.994	69.810
5366.495	39.900	0.670	2.150	1132.650	0.906	40.210
5302.298	39.900	1.260	1.580	1131.390	1.387	32.060
5249.999	39.900	1.290	1.300	1131.200	1.376	36.270
5196.291	39.900	1.000	1.470	1131.020	1.110	39.180
5126.542	39.900	0.980	1.250	1130.750	1.060	47.830
5055.287	39.900	0.640	2.020	1130.290	0.848	48.680
4991.123	39.900	1.110	1.370	1129.100	1.206	39.260
4927.485	39.900	0.990	1.270	1128.870	1.072	48.330
4872.023	39.900	0.600	1.980	1128.490	0.800	51.550
4806.596	39.900	1.220	1.410	1127.400	1.321	37.570
4746.008	39.900	0.950	1.700	1127.100	1.097	38.500
4673.393	39.900	0.800	1.120	1126.740	0.864	64.100
4589.861	39.900	0.550	1.800	1126.190	0.715	68.280
4527.998	39.900	0.910	1.410	1124.950	1.011	47.360
4456.484	39.900	0.590	1.420	1124.500	0.693	70.890
4401.417	39.900	0.540	1.830	1123.850	0.711	65.420
4315.002	39.900	0.670	0.990	1122.720	0.720	92.010
4251.317	39.900	0.490	1.730	1122.270	0.643	77.520
4165.555	39.900	0.740	0.790	1120.740	0.772	85.750
4069.945	39.900	0.820	0.890	1120.560	0.860	86.090
4009.968	39.900	0.550	1.830	1120.250	0.721	65.070
3940.564	39.900	0.950	1.000	1118.980	1.001	59.290
3896.197	39.900	0.750	1.590	1118.810	0.879	51.770
3840.973	39.900	0.610	1.870	1118.170	0.788	61.730
3728.794	39.900	1.040	1.520	1116.980	1.158	37.950
3677.115	39.900	0.710	2.210	1116.560	0.959	36.960
3608.366	39.900	1.320	1.790	1115.410	1.483	26.990
3549.750	39.900	1.070	1.440	1115.060	1.176	54.300
3486.635	39.900	1.080	0.740	1114.920	1.108	69.220
3428.311	39.900	0.990	0.690	1114.870	1.014	72.530
3352.924	39.900	0.600	2.040	1114.680	0.812	47.010
3279.829	39.900	1.670	0.770	1114.140	1.700	60.820
3222.093	39.900	2.170	0.410	1114.110	2.179	71.600
3169.197	39.900	3.480	0.200	1114.110	3.482	165.390
3102.216	39.900	3.990	0.140	1114.110	3.991	140.430
3017.947	39.900	4.640	0.110	1114.110	4.641	252.350
2955.187	39.900	4.960	0.070	1114.110	4.960	226.920
2883.274	39.900	5.680	0.070	1114.110	5.680	217.910
2809.471	39.900	6.110	0.050	1114.110	6.110	276.020
2747.531	39.900	6.500	0.050	1114.100	6.500	371.540

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
2680.139	39.900	6.940	0.020	1114.100	6.940	436.720
2613.466	39.900	7.170	0.030	1114.100	7.170	355.400
2538.669	39.900	8.030	0.030	1114.100	8.030	352.170
2477.451	39.900	7.960	0.030	1114.100	7.960	429.850
2389.032	39.900	0.710	1.700	1114.090	0.857	78.430
2317.392	39.900	0.950	1.330	1112.890	1.040	43.670
2261.591	39.900	1.380	0.720	1112.790	1.406	62.050
2200.218	39.900	1.180	2.610	1112.630	1.527	22.540
2101.242	39.900	0.660	3.930	1110.080	1.447	23.460
2029.967	39.900	0.700	7.230	1103.150	3.364	11.850
1944.020	39.900	24.520	0.020	1101.320	24.520	162.640
1871.683	39.900	31.370	0.010	1101.320	31.370	212.010
1799.654	39.900	31.760	0.010	1101.320	31.760	189.530
1725.811	39.900	10.360	0.070	1101.320	10.360	103.400
1653.732	39.900	0.680	1.670	1101.300	0.822	53.990
1598.329	39.900	0.700	1.520	1100.810	0.818	54.860
1530.831	39.900	0.930	1.260	1100.420	1.011	59.540
1458.496	39.900	0.760	1.670	1099.940	0.902	54.750
1375.408	39.900	0.870	1.430	1099.270	0.974	55.240
1261.649	39.900	1.110	1.940	1098.480	1.302	29.460
1170.844	39.900	1.080	1.940	1097.730	1.272	34.650
1067.171	39.900	1.170	1.330	1097.050	1.260	50.950
1012.672	39.900	0.930	2.230	1096.620	1.183	35.990
939.571	39.900	0.930	1.300	1095.940	1.016	60.170
868.558	39.900	0.650	1.920	1095.330	0.838	56.290
793.093	39.900	0.910	1.350	1094.450	1.003	56.550
727.987	39.900	0.780	1.630	1093.930	0.915	70.690
674.135	39.900	0.690	1.800	1093.220	0.855	53.790
607.964	39.900	0.830	1.670	1092.460	0.972	54.470
540.102	39.900	1.130	1.040	1092.020	1.185	86.330
458.236	39.900	1.270	1.500	1091.570	1.385	59.450
366.765	39.900	1.110	1.860	1090.840	1.286	33.320
277.688	39.900	0.920	2.050	1090.010	1.134	35.420
180.728	39.900	1.150	1.360	1089.230	1.244	56.390
82.541	39.900	1.130	1.180	1088.650	1.201	90.300

Table E3 : HEC-RAS Output file for Stream B1 (1:50 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
2847.391	62.950	0.590	0.770	1174.170	0.620	250.300
2750.413	62.950	1.290	0.250	1173.270	1.293	250.050
2615.384	62.950	1.630	0.230	1172.360	1.633	329.040
2513.918	62.950	0.840	0.340	1170.780	0.846	287.640
2405.124	62.950	1.510	0.210	1169.490	1.512	325.310
2296.916	62.950	0.930	0.400	1168.040	0.938	273.210
2174.581	62.950	1.000	0.370	1166.820	1.007	216.930
2046.338	62.950	1.300	0.370	1165.910	1.307	202.620
1933.656	62.950	0.950	0.530	1164.570	0.964	174.640
1828.033	62.950	1.020	0.400	1162.960	1.028	218.870
1736.299	62.950	1.200	0.330	1162.090	1.206	222.890
1619.901	62.950	0.740	0.750	1160.460	0.769	188.960
1486.178	62.950	1.540	0.270	1159.550	1.544	208.410
1413.312	62.950	1.350	0.290	1159.200	1.354	197.110
1354.609	62.950	1.350	0.420	1157.540	1.359	162.640
1279.395	62.950	1.430	0.260	1156.960	1.433	267.390
1192.853	62.950	1.580	0.190	1156.110	1.582	379.420
1106.782	62.950	0.650	0.390	1154.600	0.658	348.730
991.751	62.950	0.990	0.300	1153.450	0.995	305.970
895.955	62.950	0.820	0.480	1152.230	0.832	233.520
802.870	62.950	1.290	0.250	1151.280	1.293	376.580
721.523	62.950	0.560	0.720	1149.940	0.586	250.180
586.586	62.950	1.850	0.250	1148.820	1.853	309.370
462.018	62.950	1.800	0.350	1147.320	1.806	189.980
313.590	62.950	1.020	1.580	1145.250	1.147	98.640

Table E4 : HEC-RAS Output file for Stream B2 (1:50 yr Flood Event)

River Station	Flowrate	Flow Depth	W.S. Elev	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m)	(m/s)	(m)	(m)	(m)
11801.540	62.000	0.370	1193.250	3.080	1193.730	0.854	87.590
11686.940	62.000	0.670	1192.190	1.250	1192.270	0.750	134.460
11438.280	62.000	0.560	1190.180	1.210	1190.250	0.635	174.630
11291.490	62.000	0.450	1188.240	1.660	1188.380	0.590	136.860
11166.130	62.000	0.930	1186.950	1.360	1187.040	1.024	87.280
11024.530	62.000	0.400	1185.740	1.420	1185.840	0.503	171.750
10885.390	62.000	0.480	1184.080	1.050	1184.140	0.536	263.330
10734.940	62.000	0.330	1182.240	1.200	1182.310	0.403	265.220
10603.020	62.000	0.590	1180.560	1.160	1180.630	0.659	219.740
10449.280	62.000	0.660	1178.990	1.440	1179.090	0.766	114.600
10356.160	62.000	0.730	1177.740	2.110	1177.960	0.957	66.090
10251.470	62.000	0.790	1176.710	0.960	1176.760	0.837	173.770
10162.840	62.000	0.450	1175.930	1.450	1176.030	0.557	208.970
10044.280	62.000	0.400	1174.380	0.800	1174.410	0.433	256.940
9971.659	62.000	0.380	1173.750	1.540	1173.870	0.501	172.940
9853.558	62.000	0.470	1172.200	1.030	1172.250	0.524	257.950
9722.764	62.000	0.610	1170.450	1.850	1170.630	0.784	98.200
9593.489	62.000	1.100	1169.110	1.330	1169.200	1.190	76.980
9444.750	62.000	0.430	1168.070	1.380	1168.170	0.527	167.380
9297.891	62.000	0.450	1166.250	1.360	1166.340	0.544	154.990
9172.924	62.000	1.070	1164.450	1.850	1164.620	1.244	94.500
9056.092	62.000	1.060	1163.060	1.330	1163.150	1.150	121.440
8968.864	62.000	0.770	1162.570	1.090	1162.630	0.831	134.730
8868.550	62.000	0.500	1161.660	1.740	1161.810	0.654	118.260
8746.674	62.000	0.680	1160.660	0.880	1160.700	0.719	135.820
8641.287	62.000	0.930	1160.150	1.240	1160.230	1.008	199.980
8576.624	62.000	0.900	1159.070	2.420	1159.360	1.198	43.960
8448.244	62.000	0.680	1157.550	1.410	1157.650	0.781	111.950
8339.120	62.000	0.790	1156.190	1.610	1156.320	0.922	148.280
8274.897	62.000	0.720	1155.010	1.380	1155.100	0.817	109.940
8214.739	62.000	0.750	1154.290	1.830	1154.460	0.921	90.090
8130.717	62.000	0.730	1153.210	1.900	1153.400	0.914	63.260
8043.410	62.000	0.950	1152.190	1.810	1152.350	1.117	83.080
7964.533	62.000	0.880	1151.430	1.810	1151.600	1.047	53.600
7912.995	62.000	0.880	1150.830	2.110	1151.060	1.107	65.300
7830.576	62.000	0.950	1149.920	1.080	1149.980	1.009	184.990
7767.910	62.000	0.790	1149.150	1.760	1149.310	0.948	113.370
7678.205	62.000	0.490	1147.970	1.050	1148.030	0.546	226.780
7606.022	62.000	0.580	1147.220	1.300	1147.300	0.666	187.850
7520.219	62.000	0.950	1146.220	1.370	1146.310	1.046	141.830
7422.424	62.000	0.680	1145.100	1.330	1145.190	0.770	171.880
7369.143	62.000	1.050	1144.640	1.150	1144.710	1.117	159.840
7285.560	62.000	0.770	1143.650	1.760	1143.810	0.928	115.610
7122.444	62.000	2.170	1141.840	0.790	1141.870	2.202	91.750
7064.870	178.700	1.550	1141.320	2.220	1141.570	1.801	160.750
6997.263	178.700	1.620	1140.620	1.580	1140.750	1.747	232.300

River Station	Flowrate	Flow Depth	W.S. Elev	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m)	(m/s)	(m)	(m)	(m)
6876.330	178.700	1.370	1139.300	2.130	1139.530	1.601	156.600
6742.589	178.700	1.510	1138.320	1.430	1138.420	1.614	224.230
6681.747	178.700	1.130	1137.680	1.920	1137.870	1.318	255.340
6590.804	178.700	1.740	1136.520	1.560	1136.650	1.864	271.440
6512.507	178.700	1.120	1135.820	1.490	1135.940	1.233	285.340
6380.292	178.700	1.300	1135.260	1.160	1135.330	1.369	224.540
6272.834	178.700	2.070	1135.180	0.810	1135.210	2.103	167.160
6211.197	178.700	2.630	1135.120	1.040	1135.170	2.685	96.990
6148.354	178.700	1.310	1134.630	2.820	1135.030	1.715	79.340
6093.315	178.700	0.970	1131.790	5.710	1133.450	2.632	51.190
6033.452	178.700	1.190	1130.170	3.820	1130.910	1.934	55.240
5961.870	178.700	2.200	1130.270	1.570	1130.390	2.326	100.260
5864.661	178.700	1.090	1129.940	1.470	1130.050	1.200	196.270
5807.971	178.700	1.240	1129.190	2.770	1129.580	1.631	84.520
5752.516	178.700	0.940	1128.070	3.140	1128.570	1.443	96.600
5662.033	178.700	1.440	1126.130	2.760	1126.510	1.828	116.010
5618.673	178.700	1.650	1125.680	2.260	1125.940	1.910	71.490
5558.723	178.700	1.850	1125.040	2.820	1125.450	2.255	78.530
5477.133	178.700	1.670	1124.210	1.730	1124.360	1.823	172.690
5410.098	178.700	1.820	1123.620	1.810	1123.790	1.987	192.930
5310.594	178.700	1.330	1122.580	1.970	1122.770	1.528	165.750
5248.538	178.700	1.250	1121.760	2.210	1122.010	1.499	155.010
5148.934	178.700	1.410	1120.830	1.910	1121.010	1.596	120.580
5051.025	178.700	1.630	1120.220	2.090	1120.440	1.853	84.750
4948.647	178.700	1.320	1119.260	2.610	1119.610	1.667	99.630
4904.011	178.700	1.250	1118.750	2.160	1118.990	1.488	148.430
4802.839	178.700	1.300	1117.800	1.700	1117.940	1.447	199.350
4723.724	178.700	1.090	1116.820	2.230	1117.070	1.343	159.370
4679.384	178.700	2.070	1115.950	1.300	1116.030	2.156	169.070
4602.057	178.700	0.920	1115.370	2.080	1115.590	1.141	196.640
4517.995	178.700	1.840	1114.710	1.140	1114.780	1.906	202.180
4452.201	178.700	1.300	1114.280	2.080	1114.500	1.521	132.600
4398.096	178.700	1.370	1113.850	1.620	1113.990	1.504	229.300
4343.725	178.700	1.370	1113.150	1.910	1113.330	1.556	263.560
4289.029	178.700	1.040	1112.470	1.550	1112.590	1.162	265.650
4224.820	178.700	0.920	1111.640	1.860	1111.820	1.096	269.620
4161.218	178.700	0.840	1109.270	3.730	1109.980	1.549	117.350
4081.309	178.700	1.240	1107.670	2.620	1108.020	1.590	96.880
3993.751	178.700	1.780	1107.170	1.330	1107.260	1.870	172.600
3924.552	178.700	2.580	1107.210	0.400	1107.220	2.588	290.540
3844.631	178.700	2.260	1106.290	0.810	1106.320	2.293	193.900
3532.901	208.000	2.780	1104.590	0.530	1104.610	2.794	363.980
3396.013	208.000	2.880	1103.550	0.550	1103.570	2.895	261.190
3309.372	208.000	2.450	1102.400	0.590	1102.420	2.468	319.800
3181.273	208.000	2.960	1101.490	0.390	1101.490	2.968	454.240
3091.991	208.000	3.360	1100.930	0.430	1100.940	3.369	305.470
3044.872	208.000	3.120	1100.140	0.630	1100.160	3.140	263.220
2958.546	208.000	2.860	1099.180	0.460	1099.200	2.871	333.210

River Station	Flowrate	Flow Depth	W.S. Elev	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m)	(m/s)	(m)	(m)	(m)
2891.403	208.000	2.350	1098.310	0.540	1098.330	2.365	320.430
2794.563	208.000	2.720	1097.690	0.420	1097.700	2.729	378.940
2728.528	208.000	2.790	1097.090	0.480	1097.100	2.802	386.740
2643.520	208.000	2.740	1096.160	0.500	1096.170	2.753	332.970
2555.984	208.000	3.230	1095.370	0.450	1095.380	3.240	360.960
2489.424	208.000	2.880	1094.680	0.440	1094.690	2.890	379.770
2405.101	208.000	2.330	1094.060	0.410	1094.070	2.339	391.610
2325.081	208.000	1.680	1093.260	0.530	1093.280	1.694	355.840
2179.903	208.000	1.700	1091.960	0.570	1091.970	1.717	343.650
2047.556	208.000	1.460	1090.520	0.650	1090.540	1.482	366.920
1904.709	208.000	1.390	1088.960	0.590	1088.980	1.408	346.500
1789.534	208.000	1.780	1087.780	0.570	1087.790	1.797	316.530
1628.151	208.000	2.030	1086.820	0.570	1086.840	2.047	278.370
1505.420	208.000	2.610	1085.840	0.680	1085.870	2.634	213.890
1411.443	208.000	2.200	1084.670	0.670	1084.690	2.223	242.450
1278.851	208.000	1.620	1083.400	0.670	1083.420	1.643	247.500
1150.145	208.000	2.250	1082.240	0.540	1082.250	2.265	264.980
1016.540	208.000	1.390	1080.850	0.710	1080.870	1.416	305.690
874.341	208.000	1.660	1079.530	0.560	1079.540	1.676	307.960
749.162	208.000	2.110	1078.570	0.530	1078.580	2.124	362.700
652.167	208.000	1.940	1077.690	0.500	1077.700	1.953	372.420
532.707	208.000	2.530	1076.850	0.410	1076.860	2.539	455.680
412.351	208.000	0.870	1074.420	2.010	1074.630	1.076	199.780

Table E5 : HEC-RAS Output file for Stream B4 (1:50 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
3913.877	23.750	2.170	0.420	1179.870	2.179	39.740
3837.561	23.750	0.680	2.070	1174.420	0.898	26.640
3738.514	23.750	0.440	4.630	1170.730	1.533	18.230
3676.959	23.750	0.910	2.240	1168.890	1.166	20.720
3620.014	23.750	0.570	3.290	1167.400	1.122	20.070
3555.097	23.750	2.510	0.310	1166.320	2.515	52.690
3499.649	23.750	0.660	2.120	1163.200	0.889	24.750
3432.412	23.750	0.450	3.090	1161.240	0.937	28.360
3352.607	23.750	1.230	0.180	1158.570	1.232	202.360
3281.552	23.750	0.430	1.460	1155.770	0.539	77.500
3193.444	23.750	1.440	0.240	1153.360	1.443	193.100
3131.403	23.750	1.390	0.250	1151.170	1.393	192.730
3075.737	23.750	1.300	0.170	1149.950	1.301	199.300
3026.925	23.750	0.750	0.440	1148.210	0.760	118.840
2897.544	23.750	1.540	0.230	1146.390	1.543	105.160
2816.500	23.750	1.790	0.300	1145.220	1.795	100.780
2724.152	23.750	1.540	0.220	1143.970	1.542	132.090
2639.870	23.750	1.120	0.420	1142.210	1.129	88.910
2553.621	23.750	1.340	0.310	1141.080	1.345	159.660
2473.608	23.750	1.060	0.520	1139.390	1.074	107.820
2403.208	23.750	1.310	0.240	1138.760	1.313	104.050
2311.250	23.750	1.570	0.350	1137.140	1.576	107.500
2238.466	23.750	1.920	0.290	1136.500	1.924	108.850
2124.391	23.750	1.930	0.250	1135.200	1.933	98.120
2016.957	23.750	1.020	0.660	1132.800	1.042	67.290
1923.486	23.750	1.500	0.250	1131.980	1.503	122.750
1819.023	23.750	1.060	0.280	1130.480	1.064	116.880
1734.021	23.750	1.460	0.190	1129.450	1.462	155.860
1615.724	23.750	0.450	1.540	1127.020	0.571	65.230
1523.422	23.750	1.350	0.230	1126.070	1.353	166.640
1419.526	23.750	1.030	0.340	1123.850	1.036	117.770
1336.338	23.750	0.820	1.980	1121.000	1.020	30.580
1230.901	23.750	1.190	0.480	1115.720	1.202	66.580
1150.098	23.750	1.240	0.610	1113.960	1.259	58.480
1066.424	23.750	1.960	0.280	1113.410	1.964	69.820
970.952	23.750	1.090	0.440	1111.680	1.100	79.740
889.783	23.750	1.530	0.270	1111.160	1.534	83.990
787.448	23.750	2.080	0.260	1110.230	2.083	80.670
707.304	23.750	1.230	0.220	1109.280	1.232	152.250
613.813	23.750	1.240	0.250	1108.240	1.243	102.580
502.102	23.750	1.850	0.360	1107.890	1.857	68.030
428.694	23.750	1.760	0.240	1107.620	1.763	78.140
363.294	23.750	1.210	0.310	1106.670	1.215	84.310
287.839	23.750	1.220	0.650	1105.690	1.242	72.900
213.141	23.750	0.690	1.590	1105.460	0.819	46.050

Table E6 : HEC-RAS Output file for Stream B1 (1:100 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
2847.391	81.750	0.720	0.710	1174.300	0.746	258.620
2750.413	81.750	1.460	0.280	1173.440	1.464	256.690
2615.384	81.750	1.760	0.250	1172.490	1.763	332.640
2513.918	81.750	0.970	0.370	1170.920	0.977	291.670
2405.124	81.750	1.660	0.230	1169.640	1.663	329.160
2296.916	81.750	1.040	0.430	1168.150	1.049	280.220
2174.581	81.750	1.150	0.410	1166.970	1.159	221.250
2046.338	81.750	1.450	0.410	1166.060	1.459	216.560
1933.656	81.750	1.060	0.590	1164.690	1.078	177.880
1828.033	81.750	1.170	0.430	1163.120	1.179	226.720
1736.299	81.750	1.320	0.380	1162.210	1.327	229.220
1619.901	81.750	0.890	0.740	1160.610	0.918	193.940
1486.178	81.750	1.740	0.300	1159.750	1.745	217.360
1413.312	81.750	1.550	0.320	1159.390	1.555	203.240
1354.609	81.750	1.530	0.450	1157.720	1.540	175.580
1279.395	81.750	1.600	0.280	1157.130	1.604	291.190
1192.853	81.750	1.710	0.220	1156.240	1.712	382.010
1106.782	81.750	0.750	0.420	1154.700	0.759	358.520
991.751	81.750	1.100	0.330	1153.570	1.106	316.580
895.955	81.750	0.940	0.520	1152.350	0.954	241.470
802.870	81.750	1.400	0.270	1151.390	1.404	389.210
721.523	81.750	0.670	0.700	1150.040	0.695	305.140
586.586	81.750	2.000	0.270	1148.980	2.004	322.430
462.018	81.750	1.960	0.390	1147.470	1.968	192.850
313.590	81.750	1.090	1.730	1145.340	1.243	101.470

Table E7 : HEC-RAS Output file for Stream B2 (1:100 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
11801.540	80.550	0.410	3.300	1193.850	0.965	95.040
11686.940	80.550	0.730	1.360	1192.350	0.824	138.840
11438.280	80.550	0.610	1.340	1190.320	0.702	177.560
11291.490	80.550	0.500	1.790	1188.450	0.663	140.970
11166.130	80.550	1.030	1.470	1187.160	1.140	95.720
11024.530	80.550	0.440	1.570	1185.900	0.566	180.250
10885.390	80.550	0.530	1.150	1184.190	0.597	265.280
10734.940	80.550	0.360	1.340	1182.360	0.452	267.350
10603.020	80.550	0.640	1.260	1180.690	0.721	223.570
10449.280	80.550	0.740	1.530	1179.190	0.859	126.270
10356.160	80.550	0.830	2.220	1178.090	1.081	72.640
10251.470	80.550	0.850	1.070	1176.830	0.908	178.650
10162.840	80.550	0.490	1.550	1176.090	0.612	214.170
10044.280	80.550	0.450	0.880	1174.470	0.489	264.580
9971.659	80.550	0.430	1.590	1173.930	0.559	198.200
9853.558	80.550	0.510	1.130	1172.300	0.575	264.730
9722.764	80.550	0.680	1.980	1170.720	0.880	104.710
9593.489	80.550	1.200	1.460	1169.320	1.309	82.780
9444.750	80.550	0.480	1.520	1168.230	0.598	173.680
9297.891	80.550	0.510	1.470	1166.420	0.620	159.320
9172.924	80.550	1.150	1.890	1164.710	1.332	117.710
9056.092	80.550	1.150	1.350	1163.240	1.243	153.450
8968.864	80.550	0.850	1.190	1162.720	0.922	140.360
8868.550	80.550	0.560	1.840	1161.900	0.733	128.690
8746.674	80.550	0.750	1.000	1160.780	0.801	140.870
8641.287	80.550	1.000	1.290	1160.300	1.085	204.800
8576.624	80.550	1.020	2.560	1159.530	1.354	46.990
8448.244	80.550	0.750	1.570	1157.740	0.876	116.850
8339.120	80.550	0.840	1.740	1156.390	0.994	150.920
8274.897	80.550	0.790	1.510	1155.190	0.906	125.190
8214.739	80.550	0.860	1.820	1154.570	1.029	100.140
8130.717	80.550	0.790	2.200	1153.520	1.037	64.780
8043.410	80.550	1.070	1.790	1152.470	1.233	95.770
7964.533	80.550	0.980	2.040	1151.740	1.192	55.080
7912.995	80.550	1.010	2.060	1151.180	1.226	90.820
7830.576	80.550	1.010	1.150	1150.050	1.077	200.570
7767.910	80.550	0.860	1.830	1149.390	1.031	132.550
7678.205	80.550	0.540	1.160	1148.090	0.609	235.990
7606.022	80.550	0.630	1.390	1147.370	0.728	193.260
7520.219	80.550	1.020	1.420	1146.390	1.123	172.410
7422.424	80.550	0.760	1.310	1145.270	0.847	223.910
7369.143	80.550	1.120	1.220	1144.790	1.196	181.650
7285.560	80.550	0.850	1.820	1143.890	1.019	131.710
7122.444	80.550	2.370	0.810	1142.070	2.403	150.140
7064.870	232.230	1.670	2.250	1141.700	1.928	201.500
6997.263	232.230	1.710	1.740	1140.860	1.864	237.070

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
6876.330	232.230	1.480	2.280	1139.680	1.745	164.950
6742.589	232.230	1.600	1.590	1138.540	1.729	236.840
6681.747	232.230	1.220	2.020	1137.970	1.428	276.100
6590.804	232.230	1.840	1.630	1136.750	1.975	318.810
6512.507	232.230	1.200	1.620	1136.040	1.334	304.610
6380.292	232.230	1.530	1.130	1135.550	1.595	235.930
6272.834	232.230	2.290	0.890	1135.450	2.330	170.320
6211.197	232.230	2.840	1.200	1135.400	2.913	99.210
6148.354	232.230	1.500	2.900	1135.250	1.929	93.370
6093.315	232.230	1.120	5.960	1133.750	2.930	53.940
6033.452	232.230	1.330	4.240	1131.220	2.246	58.430
5961.870	232.230	2.340	1.800	1130.580	2.505	104.190
5864.661	232.230	1.260	1.500	1130.220	1.375	215.230
5807.971	232.230	1.410	2.940	1129.800	1.851	90.050
5752.516	232.230	1.030	3.500	1128.790	1.654	100.370
5662.033	232.230	1.540	3.000	1126.690	1.999	119.090
5618.673	232.230	1.830	2.530	1126.180	2.156	74.600
5558.723	232.230	2.040	2.900	1125.660	2.469	96.340
5477.133	232.230	1.780	1.890	1124.500	1.962	179.880
5410.098	232.230	1.950	1.870	1123.930	2.128	237.590
5310.594	232.230	1.470	1.940	1122.910	1.662	216.020
5248.538	232.230	1.350	2.350	1122.140	1.631	180.170
5148.934	232.230	1.670	1.830	1121.260	1.841	133.340
5051.025	232.230	1.960	1.940	1120.740	2.152	154.980
4948.647	232.230	1.490	2.650	1119.790	1.848	122.620
4904.011	232.230	1.300	2.550	1119.140	1.631	150.040
4802.839	232.230	1.410	1.820	1118.080	1.579	212.950
4723.724	232.230	1.220	2.230	1117.200	1.473	211.830
4679.384	232.230	2.190	1.460	1116.180	2.299	176.810
4602.057	232.230	1.010	2.230	1115.720	1.263	204.710
4517.995	232.230	2.000	1.230	1114.940	2.077	210.140
4452.201	232.230	1.410	2.290	1114.660	1.677	142.640
4398.096	232.230	1.460	1.750	1114.100	1.616	260.830
4343.725	232.230	1.440	2.030	1113.430	1.650	281.500
4289.029	232.230	1.140	1.620	1112.700	1.274	317.150
4224.820	232.230	1.000	1.940	1111.910	1.192	316.110
4161.218	232.230	0.940	3.850	1110.130	1.695	131.400
4081.309	232.230	1.380	2.830	1108.220	1.788	102.510
3993.751	232.230	2.160	1.120	1107.620	2.224	206.350
3924.552	232.230	2.940	0.410	1107.580	2.949	395.050
3844.631	232.230	2.470	0.870	1106.540	2.509	234.250
3532.901	271.180	3.010	0.570	1104.840	3.027	368.710
3396.013	271.180	3.120	0.610	1103.810	3.139	269.730
3309.372	271.180	2.650	0.650	1102.620	2.672	329.750
3181.273	271.180	3.200	0.420	1101.740	3.209	464.970
3091.991	271.180	3.620	0.480	1101.200	3.632	313.090
3044.872	271.180	3.360	0.690	1100.410	3.384	269.400
2958.546	271.180	3.100	0.510	1099.430	3.113	343.210

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
2891.403	271.180	2.580	0.590	1098.550	2.598	326.550
2794.563	271.180	2.930	0.470	1097.920	2.941	384.080
2728.528	271.180	3.010	0.520	1097.320	3.024	394.570
2643.520	271.180	2.970	0.550	1096.400	2.985	341.600
2555.984	271.180	3.460	0.490	1095.610	3.472	364.620
2489.424	271.180	3.110	0.480	1094.920	3.122	383.560
2405.101	271.180	2.550	0.450	1094.290	2.560	404.600
2325.081	271.180	1.880	0.580	1093.480	1.897	364.470
2179.903	271.180	1.870	0.630	1092.150	1.890	345.940
2047.556	271.180	1.610	0.710	1090.700	1.636	368.530
1904.709	271.180	1.580	0.650	1089.170	1.602	351.550
1789.534	271.180	1.990	0.620	1088.010	2.010	321.670
1628.151	271.180	2.280	0.620	1087.090	2.300	282.160
1505.420	271.180	2.860	0.750	1086.120	2.889	221.720
1411.443	271.180	2.420	0.740	1084.920	2.448	248.060
1278.851	271.180	1.870	0.720	1083.670	1.896	254.390
1150.145	271.180	2.480	0.610	1082.490	2.499	271.520
1016.540	271.180	1.590	0.760	1081.080	1.619	314.590
874.341	271.180	1.870	0.620	1079.760	1.890	318.890
749.162	271.180	2.310	0.580	1078.790	2.327	372.420
652.167	271.180	2.150	0.540	1077.910	2.165	388.940
532.707	271.180	2.720	0.450	1077.050	2.730	462.010
412.351	271.180	0.970	2.170	1074.760	1.210	213.510

Table E8 : HEC-RAS Output file for Stream B4 (1:100 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
3913.877	30.950	2.440	0.460	1180.140	2.451	42.190
3837.561	30.950	0.770	2.210	1174.540	1.019	28.820
3738.514	30.950	0.500	4.980	1170.960	1.764	19.450
3676.959	30.950	1.020	2.390	1169.030	1.311	22.590
3620.014	30.950	0.640	3.540	1167.560	1.279	21.770
3555.097	30.950	2.780	0.340	1166.600	2.786	58.670
3499.649	30.950	0.760	2.260	1163.330	1.020	26.690
3432.412	30.950	0.500	3.390	1161.390	1.086	30.450
3352.607	30.950	1.350	0.190	1158.690	1.352	208.330
3281.552	30.950	0.480	1.550	1155.830	0.602	83.830
3193.444	30.950	1.520	0.270	1153.440	1.524	195.550
3131.403	30.950	1.490	0.270	1151.280	1.494	197.830
3075.737	30.950	1.420	0.190	1150.070	1.422	204.010
3026.925	30.950	0.900	0.420	1148.360	0.909	146.250
2897.544	30.950	1.720	0.250	1146.570	1.723	112.760
2816.500	30.950	1.980	0.310	1145.420	1.985	113.830
2724.152	30.950	1.740	0.220	1144.160	1.742	167.050
2639.870	30.950	1.260	0.450	1142.350	1.270	97.000
2553.621	30.950	1.400	0.360	1141.140	1.407	160.900
2473.608	30.950	1.200	0.510	1139.520	1.213	111.830
2403.208	30.950	1.480	0.270	1138.930	1.484	110.000
2311.250	30.950	1.700	0.380	1137.270	1.707	114.980
2238.466	30.950	2.100	0.310	1136.670	2.105	116.170
2124.391	30.950	2.110	0.270	1135.390	2.114	108.260
2016.957	30.950	1.170	0.660	1132.950	1.192	77.850
1923.486	30.950	1.650	0.270	1132.140	1.654	136.740
1819.023	30.950	1.220	0.300	1130.650	1.225	126.890
1734.021	30.950	1.620	0.200	1129.610	1.622	172.180
1615.724	30.950	0.500	1.630	1127.090	0.635	72.570
1523.422	30.950	1.460	0.260	1126.190	1.463	174.190
1419.526	30.950	1.140	0.370	1123.960	1.147	125.400
1336.338	30.950	0.920	1.990	1121.110	1.122	39.160
1230.901	30.950	1.280	0.550	1115.820	1.295	68.370
1150.098	30.950	1.440	0.600	1114.170	1.458	61.060
1066.424	30.950	2.170	0.310	1113.620	2.175	76.800
970.952	30.950	1.270	0.450	1111.860	1.280	84.960
889.783	30.950	1.740	0.300	1111.370	1.745	88.410
787.448	30.950	2.260	0.290	1110.420	2.264	83.910
707.304	30.950	1.380	0.230	1109.430	1.383	165.950
613.813	30.950	1.430	0.270	1108.430	1.434	104.910
502.102	30.950	2.060	0.380	1108.100	2.067	70.910
428.694	30.950	1.970	0.270	1107.820	1.974	81.040
363.294	30.950	1.360	0.350	1106.820	1.366	86.660
287.839	30.950	1.310	0.720	1105.790	1.336	75.230
213.141	30.950	0.750	1.720	1105.540	0.901	49.180

Table E9 : HEC-RAS Output file for Stream C1 (1:50 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
5165.797	73.450	2.570	0.260	1172.760	2.573	349.440
5077.803	73.450	1.230	0.390	1171.080	1.238	252.050
4972.868	73.450	1.600	0.390	1168.940	1.608	172.820
4832.537	73.450	2.440	0.490	1166.930	2.452	131.070
4647.472	73.450	4.060	0.400	1165.750	4.068	80.510
4607.833	73.450	3.280	0.480	1164.860	3.292	77.610
4538.428	73.450	1.060	0.980	1161.740	1.109	116.600
4435.179	73.450	1.700	0.450	1159.440	1.710	149.570
4336.965	73.450	2.750	0.550	1158.450	2.765	88.900
4189.731	73.450	2.150	0.590	1155.910	2.168	93.330
4097.433	73.450	2.440	0.570	1154.430	2.457	122.620
3991.886	73.450	2.820	0.700	1152.850	2.845	64.360
3912.305	73.450	2.190	0.500	1151.780	2.203	98.050
3839.201	73.450	1.590	0.670	1150.540	1.613	91.340
3722.388	73.450	1.700	0.490	1149.060	1.712	129.300
3616.744	73.450	1.850	0.590	1147.920	1.868	82.720
3498.930	73.450	2.600	0.740	1146.620	2.628	55.870
3449.473	73.450	2.440	0.610	1145.710	2.459	68.800
3361.434	73.450	3.000	0.450	1145.250	3.010	74.340
3254.515	73.450	2.060	0.610	1143.650	2.079	99.380
3157.018	73.450	2.920	0.450	1142.940	2.930	76.900
3085.321	73.450	3.040	0.450	1141.940	3.050	85.080
3012.981	73.450	3.330	0.470	1140.720	3.341	87.530
2926.037	73.450	2.600	0.700	1138.760	2.625	64.520
2852.432	73.450	2.760	0.600	1137.930	2.778	64.610
2756.611	73.450	3.190	0.380	1136.820	3.197	97.670
2638.100	73.450	1.080	0.810	1134.900	1.113	135.040
2537.510	73.450	1.720	0.620	1132.790	1.740	94.650
2429.330	73.450	2.210	0.560	1131.840	2.226	86.170
2335.626	73.450	1.880	0.580	1130.650	1.897	100.870
2219.800	73.450	1.190	1.060	1128.350	1.247	99.590
2081.875	73.450	2.650	0.400	1127.420	2.658	105.170
2004.756	73.450	2.450	0.710	1125.590	2.476	82.460
1840.927	73.450	3.310	0.470	1123.620	3.321	74.880
1756.953	73.450	2.470	0.710	1121.900	2.496	60.760
1678.781	73.450	1.810	1.310	1119.790	1.897	46.820
1577.383	73.450	2.210	0.550	1117.950	2.225	97.630
1473.887	73.450	2.240	0.610	1116.270	2.259	149.040
1382.750	73.450	1.370	0.490	1114.520	1.382	199.820
1320.667	73.450	1.420	0.450	1113.080	1.430	228.080
1268.265	73.450	2.330	0.280	1112.360	2.334	311.870
1091.403	73.450	1.680	0.630	1110.050	1.700	123.900
992.383	73.450	1.150	0.670	1107.490	1.173	183.570
849.037	73.450	1.990	0.550	1105.140	2.005	152.270
685.138	73.450	1.780	0.770	1103.260	1.810	87.930
567.493	73.450	2.670	0.500	1102.190	2.683	97.570

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
488.558	73.450	1.880	0.740	1100.950	1.908	74.990
403.622	73.450	2.130	0.690	1099.550	2.154	73.050
318.771	73.450	2.430	0.420	1098.980	2.439	91.870
230.525	73.450	2.390	0.430	1098.620	2.399	99.080
146.810	73.450	0.870	2.490	1096.970	1.186	46.840

Table E10 : HEC-RAS Output file for Stream C2 (1:50 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
10254.000	95.950	1.050	1.790	1151.180	1.213	124.750
10179.060	95.950	0.590	1.210	1150.560	0.665	187.060
10095.080	95.950	0.640	1.850	1149.780	0.814	152.710
10031.000	95.950	0.690	1.090	1148.620	0.751	202.340
9964.037	95.950	0.470	1.490	1148.070	0.583	272.750
9857.715	95.950	0.460	1.410	1146.330	0.561	258.190
9767.405	95.950	0.610	1.670	1144.860	0.752	202.800
9633.327	95.950	0.670	1.290	1143.030	0.755	185.380
9551.840	95.950	0.500	1.800	1142.160	0.665	165.310
9478.863	95.950	0.840	1.750	1141.100	0.996	126.670
9369.524	95.950	0.990	2.500	1139.690	1.309	61.130
9271.032	95.950	0.900	2.850	1137.910	1.314	63.350
9188.561	95.950	0.740	1.870	1136.920	0.918	123.390
9110.209	95.950	0.790	2.240	1135.770	1.046	85.460
9018.335	95.950	0.910	1.500	1134.810	1.025	105.430
8920.789	95.950	0.890	2.400	1133.980	1.184	69.360
8860.976	95.950	1.000	3.160	1132.920	1.509	44.650
8768.522	95.950	1.340	2.840	1131.520	1.751	36.960
8682.872	95.950	1.520	2.040	1130.840	1.732	46.260
8595.241	95.950	0.940	2.380	1130.130	1.229	69.520
8467.253	95.950	0.790	2.260	1128.150	1.050	87.510
8357.055	95.950	1.100	1.320	1126.820	1.189	99.400
8259.417	95.950	1.010	2.540	1126.210	1.339	58.650
8164.410	95.950	0.720	2.630	1124.620	1.073	69.950
8082.921	95.950	1.310	1.700	1122.920	1.457	74.130
7983.290	95.950	0.820	2.400	1122.110	1.114	68.870
7888.902	95.950	0.720	2.420	1120.320	1.018	103.330
7814.963	95.950	1.020	1.480	1119.330	1.132	131.730
7697.200	95.950	0.990	1.580	1118.380	1.117	145.020
7634.452	95.950	0.710	2.080	1117.600	0.931	104.410
7553.532	95.950	0.560	1.380	1116.620	0.657	191.500
7477.117	95.950	0.860	1.860	1115.680	1.036	146.770
7412.587	95.950	0.850	2.390	1114.300	1.141	111.290
7339.493	95.950	0.660	1.790	1112.930	0.823	163.840
7208.170	95.950	1.160	1.220	1111.160	1.236	90.470
7084.159	95.950	0.960	2.300	1110.570	1.230	77.360
7005.049	95.950	1.540	1.670	1109.570	1.682	56.890
6921.703	95.950	1.000	2.430	1109.040	1.301	67.200
6868.900	95.950	1.100	2.930	1108.210	1.538	45.660
6700.935	95.950	1.450	1.330	1105.560	1.540	78.190
6601.194	148.450	1.400	2.630	1105.030	1.753	64.080
6489.439	148.450	1.390	2.880	1103.800	1.813	57.620
6385.386	148.450	1.040	2.460	1102.410	1.348	99.430
6289.561	148.450	1.200	2.470	1101.300	1.511	65.060
6183.089	148.450	1.330	2.890	1100.210	1.756	59.250
6059.675	148.450	0.970	2.500	1098.560	1.289	93.630

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
5915.030	148.450	1.970	1.320	1097.030	2.059	82.890
5834.771	148.450	1.060	2.800	1096.740	1.460	67.350
5715.048	231.100	1.440	2.360	1095.180	1.724	94.090
5643.172	231.100	1.330	2.900	1094.530	1.759	94.670
5566.234	231.100	1.350	2.650	1093.460	1.708	91.170
5456.106	231.100	1.180	2.670	1092.250	1.543	120.060
5270.899	231.100	4.230	0.580	1091.960	4.247	140.320
5193.764	231.100	3.330	0.710	1091.940	3.356	148.870
5124.379	231.100	3.760	0.630	1091.000	3.780	150.880
5036.827	231.100	3.910	0.550	1090.230	3.925	200.490
4949.319	231.100	2.180	2.130	1087.990	2.411	105.430
4848.525	231.100	3.720	0.640	1087.880	3.741	160.400
4760.467	231.100	2.000	1.300	1085.900	2.086	137.570
4691.717	231.100	3.570	0.590	1085.860	3.588	170.680
4613.453	231.100	3.230	0.560	1085.160	3.246	177.550
4542.684	231.100	2.690	0.580	1084.400	2.707	209.710
4460.434	231.100	2.780	0.620	1083.470	2.800	184.350
4324.557	231.100	2.450	0.550	1082.290	2.465	336.390
4242.187	231.100	2.620	0.530	1081.200	2.634	303.670
4155.147	231.100	2.750	0.640	1080.270	2.771	182.620
4058.655	231.100	3.640	0.640	1079.470	3.661	150.240
3949.049	231.100	3.720	0.960	1078.270	3.767	136.190
3839.485	231.100	3.080	0.870	1076.440	3.119	118.810
3724.340	231.100	3.370	0.630	1075.340	3.390	148.110
3625.253	231.100	3.350	0.540	1074.530	3.365	235.970
3534.860	231.100	4.290	0.550	1073.980	4.305	154.280
3423.452	231.100	3.190	0.840	1073.220	3.226	145.500
3320.863	231.100	4.070	0.950	1071.940	4.116	103.130
3236.028	231.100	3.910	1.190	1070.340	3.982	87.540
3143.227	231.100	4.640	0.810	1069.170	4.673	101.990
3066.790	231.100	4.080	0.670	1068.590	4.103	122.420
3009.456	231.100	3.620	0.860	1067.760	3.658	105.520
2850.885	295.100	4.140	0.690	1066.930	4.164	145.260
2750.625	295.100	3.900	0.800	1065.970	3.933	199.310
2594.399	295.100	2.720	1.490	1062.860	2.833	154.290
2459.871	295.100	3.000	0.620	1061.010	3.020	217.830
2268.970	295.100	4.460	0.550	1060.510	4.475	162.150
2202.573	295.100	4.710	0.590	1060.140	4.728	148.040
2134.785	295.100	4.040	1.050	1059.440	4.096	102.300
2060.211	295.100	4.730	0.750	1058.380	4.759	134.820
1979.352	295.100	3.870	0.950	1057.350	3.916	126.570
1920.426	295.100	3.850	0.810	1055.780	3.883	196.050
1810.135	295.100	4.860	0.680	1054.900	4.884	139.390
1712.399	295.100	4.310	1.190	1054.120	4.382	101.490
1588.463	295.100	4.500	1.000	1052.420	4.551	95.260
1507.334	295.100	4.570	0.900	1050.980	4.611	121.860
1420.372	295.100	3.820	1.050	1049.890	3.876	107.190
1333.858	295.100	4.970	0.730	1049.130	4.997	127.030

1263.062	295.100	4.250	0.820	1048.550	4.284	128.100
1184.723	295.100	4.140	0.890	1047.500	4.180	125.730
1092.381	295.100	4.480	0.770	1046.710	4.510	144.210
940.361	295.100	3.070	1.010	1045.110	3.122	154.170
833.877	295.100	4.190	0.910	1043.870	4.232	112.980
731.166	295.100	4.600	0.890	1042.610	4.640	136.330
647.438	295.100	4.010	0.660	1041.980	4.032	142.920
500.401	295.100	6.260	0.820	1041.560	6.294	81.700
410.027	295.100	4.540	1.640	1040.680	4.677	63.220
266.569	295.100	4.390	1.160	1037.790	4.459	85.270
167.883	295.100	2.690	1.670	1035.240	2.832	113.530

Table E11 : HEC-RAS Output file for Stream C3 (1:50 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
3473.882	43.300	1.580	0.420	1155.930	1.589	90.340
3428.771	43.300	1.350	0.400	1155.130	1.358	102.120
3383.039	43.300	1.600	0.410	1154.260	1.609	104.760
3312.376	43.300	1.190	0.520	1152.960	1.204	97.370
3209.240	43.300	1.590	0.360	1151.960	1.597	109.420
3179.323	43.300	1.590	0.300	1151.480	1.595	115.460
3138.404	43.300	0.980	0.480	1150.640	0.992	124.060
3050.887	43.300	1.110	0.380	1149.340	1.117	129.320
2980.389	43.300	1.300	0.440	1148.070	1.310	112.350
2884.741	43.300	1.550	0.510	1146.680	1.563	87.350
2782.976	43.300	1.370	0.370	1145.580	1.377	126.520
2706.854	43.300	1.730	0.540	1144.200	1.745	82.830
2631.503	43.300	1.820	0.270	1143.410	1.824	167.790
2583.599	43.300	2.580	0.290	1142.460	2.584	135.200
2526.394	43.300	2.240	0.330	1141.880	2.246	127.770
2498.896	43.300	2.320	0.290	1141.400	2.324	127.750
2451.464	43.300	2.430	0.320	1140.380	2.435	130.490
2401.606	43.300	1.810	0.550	1139.470	1.825	65.250
2346.079	43.300	2.110	0.540	1139.450	2.125	67.160
2305.397	43.300	1.620	0.380	1138.500	1.627	108.880
2202.680	43.300	2.670	0.260	1138.160	2.673	100.640
2152.446	43.300	2.280	0.300	1137.590	2.285	109.590
2092.920	43.300	1.710	0.700	1135.940	1.735	58.170
2015.003	43.300	1.250	0.430	1133.940	1.259	116.720
1871.806	43.300	1.670	0.680	1132.240	1.694	60.780
1808.358	43.300	2.580	0.460	1131.070	2.591	63.620
1755.580	43.300	2.580	0.600	1130.230	2.598	44.450
1683.437	43.300	3.150	0.570	1129.300	3.167	42.400
1647.825	43.300	2.840	0.530	1128.400	2.854	44.930
1559.135	43.300	3.590	0.570	1127.720	3.607	34.160
1507.031	43.300	3.090	0.400	1127.200	3.098	61.220
1464.998	43.300	2.970	0.750	1126.380	2.999	31.320
1416.459	43.300	3.150	0.680	1125.180	3.174	31.370
1367.458	43.300	2.940	0.580	1124.290	2.957	38.630
1325.690	43.300	2.480	0.700	1123.260	2.505	37.260
1277.357	43.300	2.760	0.680	1121.780	2.784	34.040
1209.626	43.300	3.130	0.580	1120.700	3.147	37.620
1165.091	43.300	2.630	0.720	1119.700	2.656	34.820
1081.555	43.300	3.680	0.240	1119.460	3.683	72.670
1031.034	43.300	3.280	0.320	1119.320	3.285	72.510
972.990	43.300	2.380	0.530	1118.840	2.394	69.980
925.019	43.300	2.110	0.610	1117.320	2.129	65.100
879.833	43.300	2.850	0.330	1116.840	2.856	61.000
840.610	43.300	2.500	0.420	1116.460	2.509	65.010
766.608	43.300	3.310	0.450	1115.370	3.320	47.800
727.779	43.300	2.780	0.520	1114.840	2.794	44.740

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
682.795	43.300	2.740	0.300	1114.390	2.745	104.780
628.614	43.300	2.120	0.380	1114.000	2.127	76.640
594.357	43.300	2.200	0.520	1113.390	2.214	51.380
544.951	43.300	2.630	0.430	1112.610	2.639	63.200
491.816	43.300	2.220	0.380	1112.130	2.227	70.940
446.613	43.300	2.560	0.480	1111.570	2.572	49.900
401.484	43.300	3.180	0.390	1111.150	3.188	53.840
367.862	43.300	2.660	0.470	1110.710	2.671	56.190
324.981	43.300	2.920	0.360	1110.280	2.927	63.970
280.725	43.300	2.750	0.340	1109.930	2.756	67.790
250.716	43.300	2.290	0.400	1109.540	2.298	78.820
198.771	43.300	1.910	0.370	1108.890	1.917	86.400
155.982	43.300	2.420	0.390	1108.410	2.428	67.560
113.276	43.300	0.800	2.190	1106.620	1.044	40.710

Table E12 : HEC-RAS Output file for Stream C5 (1:50 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
4477.510	48.250	3.800	0.600	1164.170	3.818	32.250
4428.453	48.250	1.200	2.820	1159.570	1.605	21.420
4393.124	48.250	0.730	5.830	1158.410	2.462	16.750
4353.850	48.250	3.030	0.710	1156.980	3.056	37.490
4309.802	48.250	2.020	1.080	1154.460	2.079	33.320
4265.556	48.250	3.280	0.490	1154.440	3.292	44.160
4222.815	48.250	3.290	0.530	1153.270	3.304	41.450
4188.058	48.250	4.050	0.500	1152.700	4.063	38.690
4151.762	48.250	1.350	2.400	1149.520	1.644	22.790
4124.426	48.250	3.280	0.740	1149.420	3.308	31.950
4081.511	48.250	3.120	0.330	1148.550	3.126	126.260
4039.187	48.250	2.220	0.670	1146.300	2.243	78.210
3978.870	48.250	2.720	0.530	1144.710	2.734	55.630
3932.305	48.250	2.560	0.600	1142.540	2.578	52.470
3889.634	48.250	1.760	0.850	1140.270	1.797	55.050
3849.606	48.250	3.010	0.490	1140.250	3.022	50.560
3804.754	48.250	1.420	2.820	1136.040	1.825	21.410
3761.496	48.250	1.970	0.420	1132.270	1.979	72.210
3707.977	48.250	0.990	2.450	1127.970	1.296	32.540
3664.193	48.250	2.500	0.410	1127.510	2.509	88.270
3618.009	48.250	1.860	0.430	1125.750	1.869	103.060
3567.819	48.250	1.840	0.260	1125.110	1.843	175.500
3523.565	48.250	1.970	0.340	1123.980	1.976	165.450
3473.710	48.250	1.830	0.390	1123.190	1.838	99.200
3428.117	48.250	2.130	0.250	1122.780	2.133	136.490
3367.181	48.250	2.070	0.780	1121.590	2.101	45.640
3287.910	48.250	1.600	0.520	1119.430	1.614	94.650
3248.861	48.250	2.690	0.340	1118.710	2.696	86.430
3191.016	48.250	1.250	0.590	1116.880	1.268	144.380
3117.710	48.250	1.600	0.330	1115.920	1.606	139.030
3062.852	48.250	1.110	0.500	1114.730	1.123	137.500
3003.901	48.250	1.750	0.390	1113.760	1.758	119.960
2939.320	48.250	1.660	0.500	1112.970	1.673	95.980
2866.932	48.250	2.060	0.330	1112.030	2.066	138.000
2797.762	48.250	1.510	0.500	1111.010	1.523	112.570
2724.568	48.250	1.720	0.560	1109.640	1.736	91.620
2651.589	48.250	3.420	0.300	1109.310	3.425	71.920
2584.027	48.250	3.540	0.450	1109.010	3.550	46.460
2519.219	48.250	2.400	0.740	1108.470	2.428	43.070
2454.766	48.250	2.430	0.690	1107.240	2.454	43.030
2405.041	48.250	2.230	0.750	1105.980	2.259	45.030
2336.775	48.250	2.480	0.460	1105.170	2.491	68.120
2291.798	48.250	3.000	0.340	1104.710	3.006	74.730
2238.046	48.250	1.640	0.570	1103.560	1.657	68.420
2181.979	48.250	2.420	0.540	1102.290	2.435	57.260
2122.331	48.250	1.970	0.610	1101.450	1.989	56.880

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
2058.724	48.250	3.410	0.390	1101.010	3.418	59.550
2012.177	48.250	3.120	0.490	1100.680	3.132	53.750
1962.634	48.250	3.100	0.450	1100.080	3.110	54.590
1915.813	48.250	2.090	0.860	1098.080	2.128	37.930
1856.996	48.250	3.230	0.470	1097.310	3.241	53.470
1800.188	48.250	2.890	0.470	1096.660	2.901	57.730
1738.519	48.250	2.680	0.370	1096.170	2.687	68.750
1683.727	48.250	1.510	0.580	1094.800	1.527	74.770
1645.382	48.250	1.630	0.650	1093.370	1.652	72.630
1605.203	48.250	1.630	0.320	1093.360	1.635	117.520
1559.949	48.250	1.570	0.390	1092.130	1.578	111.340
1518.195	48.250	1.640	0.430	1091.600	1.649	80.310
1455.266	48.250	2.510	0.340	1090.620	2.516	81.340
1406.743	48.250	1.310	0.550	1089.240	1.325	87.950
1338.188	48.250	2.730	0.270	1088.630	2.734	122.590
1253.007	48.250	1.100	0.870	1087.110	1.139	68.020
1196.506	48.250	2.360	0.330	1086.340	2.366	107.360
1138.518	48.250	1.990	0.350	1085.260	1.996	126.250
1071.329	48.250	1.810	0.380	1083.780	1.817	116.940
1008.141	48.250	2.230	0.520	1083.070	2.244	80.050
945.342	48.250	2.650	0.260	1082.550	2.653	128.840
918.741	48.250	0.830	1.250	1080.870	0.910	74.680
808.783	48.250	1.780	0.330	1079.690	1.786	122.620
761.558	48.250	1.540	0.300	1079.340	1.545	137.420
709.778	48.250	2.000	0.510	1078.000	2.013	63.510
649.210	48.250	2.770	0.440	1077.270	2.780	59.570
621.139	48.250	2.080	0.450	1075.870	2.090	85.090
546.346	48.250	3.120	0.670	1075.120	3.143	39.470
504.875	48.250	2.790	0.600	1074.330	2.808	45.340
421.181	48.250	2.940	0.380	1072.930	2.947	79.980
376.915	48.250	2.810	0.510	1071.740	2.823	49.890
340.665	48.250	2.140	0.870	1070.850	2.179	39.020
275.531	48.250	3.450	0.440	1070.150	3.460	55.230
227.213	48.250	2.790	0.540	1068.830	2.805	52.560
183.489	48.250	3.000	0.400	1068.380	3.008	70.550
134.435	48.250	2.730	0.510	1067.050	2.743	60.720
84.754	48.250	1.030	2.590	1065.060	1.372	27.690

Table E13 : HEC-RAS Output file for Stream C1 (1:100 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
5165.797	95.350	2.700	0.290	1172.890	2.704	353.480
5077.803	95.350	1.400	0.410	1171.250	1.409	259.520
4972.868	95.350	1.750	0.440	1169.090	1.760	176.360
4832.537	95.350	2.830	0.470	1167.320	2.841	138.590
4647.472	95.350	4.550	0.420	1166.240	4.559	100.080
4607.833	95.350	3.700	0.510	1165.280	3.713	93.550
4538.428	95.350	1.140	1.130	1161.840	1.205	120.780
4435.179	95.350	1.970	0.460	1159.710	1.981	157.780
4336.965	95.350	3.090	0.570	1158.800	3.107	105.910
4189.731	95.350	2.370	0.650	1156.130	2.392	100.440
4097.433	95.350	2.670	0.610	1154.670	2.689	126.270
3991.886	95.350	3.120	0.760	1153.160	3.149	69.820
3912.305	95.350	2.450	0.560	1152.040	2.466	103.040
3839.201	95.350	1.790	0.750	1150.750	1.819	95.730
3722.388	95.350	1.930	0.530	1149.290	1.944	131.750
3616.744	95.350	2.160	0.640	1148.230	2.181	86.380
3498.930	95.350	2.940	0.810	1146.960	2.973	59.280
3449.473	95.350	2.780	0.660	1146.050	2.802	71.980
3361.434	95.350	3.310	0.510	1145.560	3.323	77.320
3254.515	95.350	2.390	0.620	1143.980	2.410	102.350
3157.018	95.350	3.310	0.490	1143.330	3.322	80.640
3085.321	95.350	3.400	0.490	1142.300	3.412	93.080
3012.981	95.350	3.660	0.520	1141.050	3.674	91.950
2926.037	95.350	2.950	0.740	1139.120	2.978	69.410
2852.432	95.350	3.140	0.640	1138.310	3.161	69.520
2756.611	95.350	3.510	0.420	1137.140	3.519	103.840
2638.100	95.350	1.260	0.820	1135.070	1.294	172.550
2537.510	95.350	2.010	0.650	1133.080	2.032	100.660
2429.330	95.350	2.510	0.610	1132.140	2.529	97.730
2335.626	95.350	2.060	0.660	1130.850	2.082	104.680
2219.800	95.350	1.500	0.900	1128.640	1.541	145.430
2081.875	95.350	2.980	0.430	1127.760	2.989	115.630
2004.756	95.350	2.810	0.690	1125.960	2.834	103.120
1840.927	95.350	3.700	0.510	1124.010	3.713	81.830
1756.953	95.350	2.830	0.760	1122.260	2.859	66.100
1678.781	95.350	2.190	1.240	1120.160	2.268	72.990
1577.383	95.350	2.450	0.600	1118.190	2.468	106.970
1473.887	95.350	2.400	0.660	1116.430	2.422	158.120
1382.750	95.350	1.500	0.540	1114.650	1.515	206.970
1320.667	95.350	1.560	0.490	1113.220	1.572	237.280
1268.265	95.350	2.490	0.310	1112.510	2.495	317.280
1091.403	95.350	1.840	0.690	1110.210	1.864	129.830
992.383	95.350	1.270	0.720	1107.620	1.296	199.940
849.037	95.350	2.160	0.600	1105.320	2.178	160.630
685.138	95.350	2.040	0.810	1103.520	2.073	95.700
567.493	95.350	2.940	0.550	1102.460	2.955	102.090

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
488.558	95.350	2.140	0.800	1101.220	2.173	79.090
403.622	95.350	2.440	0.730	1099.870	2.467	78.250
318.771	95.350	2.730	0.470	1099.280	2.741	95.290
230.525	95.350	2.670	0.480	1098.900	2.682	102.860
146.810	95.350	1.000	2.680	1097.140	1.366	49.430

Table E14 : HEC-RAS Output file for Stream C2 (1:100 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
10254.000	124.450	1.150	1.840	1151.300	1.323	160.280
10179.060	124.450	0.660	1.330	1150.650	0.750	192.750
10095.080	124.450	0.710	1.980	1149.880	0.910	161.880
10031.000	124.450	0.760	1.210	1148.700	0.835	213.270
9964.037	124.450	0.520	1.610	1148.140	0.652	290.420
9857.715	124.450	0.510	1.560	1146.400	0.634	259.880
9767.405	124.450	0.660	1.830	1144.940	0.831	205.780
9633.327	124.450	0.740	1.430	1143.110	0.844	190.500
9551.840	124.450	0.570	1.950	1142.250	0.764	169.120
9478.863	124.450	0.930	1.870	1141.210	1.108	135.070
9369.524	124.450	1.130	2.640	1139.860	1.485	66.470
9271.032	124.450	0.990	3.110	1138.080	1.483	69.900
9188.561	124.450	0.820	2.020	1137.030	1.028	132.270
9110.209	124.450	0.900	2.370	1135.910	1.186	92.090
9018.335	124.450	1.030	1.620	1134.950	1.164	110.290
8920.789	124.450	1.020	2.550	1134.140	1.351	74.220
8860.976	124.450	1.150	3.370	1133.140	1.729	47.440
8768.522	124.450	1.520	3.060	1131.760	1.997	39.470
8682.872	124.450	1.660	2.310	1131.040	1.932	48.040
8595.241	124.450	1.060	2.540	1130.290	1.389	75.950
8467.253	124.450	0.880	2.470	1128.290	1.191	94.860
8357.055	124.450	1.240	1.430	1126.970	1.344	101.430
8259.417	124.450	1.140	2.690	1126.390	1.509	63.430
8164.410	124.450	0.810	2.940	1124.790	1.251	72.140
8082.921	124.450	1.450	1.830	1123.090	1.621	82.090
7983.290	124.450	0.980	2.360	1122.270	1.264	92.620
7888.902	124.450	0.810	2.520	1120.430	1.134	127.520
7814.963	124.450	1.120	1.580	1119.450	1.247	149.220
7697.200	124.450	1.070	1.730	1118.480	1.223	147.060
7634.452	124.450	0.800	2.240	1117.730	1.056	109.310
7553.532	124.450	0.620	1.530	1116.700	0.739	193.410
7477.117	124.450	0.920	2.010	1115.780	1.126	151.380
7412.587	124.450	0.910	2.610	1114.420	1.257	116.190
7339.493	124.450	0.720	1.960	1113.020	0.916	165.720
7208.170	124.450	1.310	1.340	1111.330	1.402	97.880
7084.159	124.450	1.070	2.480	1110.720	1.383	80.080
7005.049	124.450	1.700	1.870	1109.770	1.878	60.030
6921.703	124.450	1.120	2.610	1109.210	1.467	69.420
6868.900	124.450	1.260	3.110	1108.420	1.753	49.250
6700.935	124.450	1.640	1.410	1105.770	1.741	83.260
6601.194	193.050	1.600	2.790	1105.260	1.997	68.780
6489.439	193.050	1.560	3.140	1104.050	2.063	62.240
6385.386	193.050	1.140	2.760	1102.580	1.528	102.290
6289.561	193.050	1.380	2.700	1101.530	1.752	67.090
6183.089	193.050	1.500	3.140	1100.460	2.003	62.480
6059.675	193.050	1.070	2.810	1098.740	1.472	96.420

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
5915.030	193.050	2.190	1.470	1097.270	2.300	86.000
5834.771	193.050	1.230	3.000	1096.960	1.689	70.510
5715.048	300.400	1.620	2.610	1095.420	1.967	98.090
5643.172	300.400	1.500	3.100	1094.760	1.990	99.740
5566.234	300.400	1.350	3.430	1093.700	1.950	91.260
5456.106	300.400	1.580	2.170	1092.530	1.820	132.630
5270.899	300.400	4.670	0.650	1092.400	4.692	145.550
5193.764	300.400	3.770	0.760	1092.390	3.799	156.040
5124.379	300.400	4.200	0.690	1091.450	4.224	160.980
5036.827	300.400	4.290	0.600	1090.620	4.308	227.030
4949.319	300.400	2.570	1.940	1088.340	2.762	133.520
4848.525	300.400	4.080	0.710	1088.240	4.106	163.560
4760.467	300.400	2.400	1.240	1086.300	2.478	167.970
4691.717	300.400	3.970	0.650	1086.260	3.992	174.970
4613.453	300.400	3.600	0.620	1085.540	3.620	182.530
4542.684	300.400	3.040	0.640	1084.750	3.061	215.020
4460.434	300.400	3.070	0.700	1083.770	3.095	191.910
4324.557	300.400	2.700	0.600	1082.530	2.718	346.950
4242.187	300.400	2.950	0.550	1081.530	2.965	314.750
4155.147	300.400	3.180	0.680	1080.710	3.204	188.640
4058.655	300.400	4.070	0.700	1079.910	4.095	169.640
3949.049	300.400	4.120	1.020	1078.680	4.173	141.340
3839.485	300.400	3.540	0.930	1076.900	3.584	135.700
3724.340	300.400	3.770	0.710	1075.740	3.796	152.290
3625.253	300.400	3.800	0.560	1074.980	3.816	245.580
3534.860	300.400	4.760	0.600	1074.450	4.778	166.250
3423.452	300.400	3.650	0.870	1073.680	3.689	157.840
3320.863	300.400	4.600	1.000	1072.470	4.651	120.510
3236.028	300.400	4.510	1.200	1070.930	4.583	103.250
3143.227	300.400	5.240	0.850	1069.770	5.277	122.300
3066.790	300.400	4.650	0.720	1069.160	4.676	137.170
3009.456	300.400	4.190	0.910	1068.330	4.232	115.390
2850.885	384.150	4.650	0.760	1067.450	4.679	165.620
2750.625	384.150	4.310	0.830	1066.390	4.345	248.990
2594.399	384.150	3.030	1.540	1063.170	3.151	184.750
2459.871	384.150	3.560	0.640	1061.580	3.581	228.940
2268.970	384.150	5.070	0.610	1061.120	5.089	168.080
2202.573	384.150	5.310	0.650	1060.740	5.332	155.800
2134.785	384.150	4.620	1.130	1060.030	4.685	110.750
2060.211	384.150	5.320	0.800	1058.970	5.353	146.600
1979.352	384.150	4.350	1.020	1057.840	4.403	163.720
1920.426	384.150	4.330	0.840	1056.270	4.366	202.640
1810.135	384.150	5.400	0.750	1055.440	5.429	143.010
1712.399	384.150	4.840	1.270	1054.650	4.922	106.130
1588.463	384.150	5.030	1.110	1052.970	5.093	99.800
1507.334	384.150	5.090	0.980	1051.510	5.139	126.730
1420.372	384.150	4.370	1.120	1050.450	4.434	114.910
1333.858	384.150	5.510	0.810	1049.670	5.543	134.480

1263.062	384.150	4.740	0.900	1049.050	4.781	132.890
1184.723	384.150	4.610	0.980	1047.980	4.659	130.710
1092.381	384.150	4.910	0.860	1047.140	4.948	148.420
940.361	384.150	3.660	1.000	1045.690	3.711	159.700
833.877	384.150	4.830	0.950	1044.510	4.876	151.220
731.166	384.150	5.220	0.920	1043.240	5.263	147.590
647.438	384.150	4.700	0.700	1042.680	4.725	148.830
500.401	384.150	6.940	0.920	1042.260	6.983	87.200
410.027	384.150	5.150	1.750	1041.310	5.306	68.600
266.569	384.150	4.910	1.280	1038.320	4.994	91.780
167.883	384.150	3.070	1.710	1035.620	3.219	139.100

Table E15 : HEC-RAS Output file for Stream C3 (1:100 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
3473.882	56.600	1.790	0.460	1156.140	1.801	93.920
3428.771	56.600	1.550	0.440	1155.330	1.560	105.570
3383.039	56.600	1.770	0.460	1154.440	1.781	107.960
3312.376	56.600	1.370	0.560	1153.150	1.386	100.260
3209.240	56.600	1.810	0.390	1152.180	1.818	115.060
3179.323	56.600	1.780	0.340	1151.680	1.786	118.990
3138.404	56.600	1.120	0.520	1150.790	1.134	127.750
3050.887	56.600	1.280	0.410	1149.510	1.289	134.770
2980.389	56.600	1.480	0.480	1148.250	1.492	119.450
2884.741	56.600	1.730	0.560	1146.870	1.746	91.020
2782.976	56.600	1.570	0.400	1145.780	1.578	135.880
2706.854	56.600	1.920	0.590	1144.390	1.938	91.790
2631.503	56.600	2.020	0.290	1143.620	2.024	179.380
2583.599	56.600	2.800	0.310	1142.680	2.805	145.600
2526.394	56.600	2.470	0.350	1142.110	2.476	143.160
2498.896	56.600	2.530	0.320	1141.620	2.535	139.260
2451.464	56.600	2.640	0.340	1140.590	2.646	134.270
2401.606	56.600	2.010	0.620	1139.670	2.030	68.800
2346.079	56.600	2.310	0.600	1139.660	2.328	71.930
2305.397	56.600	1.900	0.390	1138.780	1.908	113.420
2202.680	56.600	2.970	0.290	1138.450	2.974	106.830
2152.446	56.600	2.540	0.320	1137.860	2.545	120.710
2092.920	56.600	1.920	0.750	1136.150	1.949	65.580
2015.003	56.600	1.410	0.470	1134.110	1.421	121.910
1871.806	56.600	1.920	0.710	1132.490	1.946	64.940
1808.358	56.600	2.910	0.480	1131.410	2.922	69.500
1755.580	56.600	2.950	0.630	1130.610	2.970	49.540
1683.437	56.600	3.550	0.600	1129.710	3.568	47.960
1647.825	56.600	3.300	0.550	1128.850	3.315	50.190
1559.135	56.600	4.000	0.630	1128.130	4.020	42.690
1507.031	56.600	3.460	0.430	1127.570	3.469	63.650
1464.998	56.600	3.370	0.800	1126.780	3.403	34.390
1416.459	56.600	3.530	0.740	1125.570	3.558	33.530
1367.458	56.600	3.300	0.640	1124.650	3.321	40.890
1325.690	56.600	2.830	0.750	1123.610	2.859	39.830
1277.357	56.600	3.140	0.730	1122.170	3.167	36.340
1209.626	56.600	3.490	0.630	1121.080	3.510	40.340
1165.091	56.600	2.970	0.780	1120.040	3.001	36.950
1081.555	56.600	3.970	0.280	1119.760	3.974	75.450
1031.034	56.600	3.550	0.360	1119.590	3.557	75.960
972.990	56.600	2.600	0.580	1119.060	2.617	74.730
925.019	56.600	2.470	0.580	1117.680	2.487	77.650
879.833	56.600	3.220	0.360	1117.210	3.227	63.850
840.610	56.600	2.860	0.440	1116.830	2.870	70.330
766.608	56.600	3.670	0.490	1115.730	3.682	51.290
727.779	56.600	3.090	0.580	1115.150	3.107	46.970

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
682.795	56.600	3.040	0.320	1114.690	3.045	117.620
628.614	56.600	2.420	0.410	1114.310	2.429	80.440
594.357	56.600	2.510	0.570	1113.710	2.527	53.960
544.951	56.600	2.960	0.470	1112.940	2.971	67.070
491.816	56.600	2.570	0.400	1112.480	2.578	73.840
446.613	56.600	2.940	0.520	1111.940	2.954	52.510
401.484	56.600	3.540	0.430	1111.510	3.549	56.960
367.862	56.600	3.010	0.500	1111.060	3.023	60.120
324.981	56.600	3.260	0.390	1110.630	3.268	68.360
280.725	56.600	3.070	0.380	1110.250	3.077	71.740
250.716	56.600	2.580	0.420	1109.830	2.589	93.960
198.771	56.600	2.180	0.400	1109.170	2.188	90.600
155.982	56.600	2.690	0.440	1108.680	2.700	70.350
113.276	56.600	0.900	2.370	1106.760	1.186	42.810

Table E16 : HEC-RAS Output file for Stream C5 (1:100 yr Flood Event)

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
4477.510	63.000	4.250	0.660	1164.620	4.272	34.340
4428.453	63.000	1.370	3.000	1159.800	1.829	23.170
4393.124	63.000	0.850	6.090	1158.690	2.740	17.950
4353.850	63.000	3.330	0.790	1157.290	3.362	40.690
4309.802	63.000	2.470	1.040	1154.900	2.525	36.900
4265.556	63.000	3.730	0.530	1154.880	3.744	47.020
4222.815	63.000	3.740	0.570	1153.730	3.757	44.580
4188.058	63.000	4.480	0.550	1153.130	4.495	41.850
4151.762	63.000	1.640	2.330	1149.790	1.917	25.050
4124.426	63.000	3.550	0.850	1149.700	3.587	33.740
4081.511	63.000	3.310	0.370	1148.740	3.317	127.060
4039.187	63.000	2.480	0.670	1146.550	2.503	89.320
3978.870	63.000	3.080	0.560	1145.070	3.096	61.610
3932.305	63.000	2.800	0.680	1142.790	2.824	57.080
3889.634	63.000	2.130	0.800	1140.630	2.163	64.720
3849.606	63.000	3.370	0.530	1140.620	3.384	54.540
3804.754	63.000	1.600	2.960	1136.270	2.047	23.960
3761.496	63.000	2.300	0.450	1132.600	2.310	82.890
3707.977	63.000	1.180	2.290	1128.130	1.447	52.410
3664.193	63.000	2.820	0.430	1127.830	2.829	94.730
3618.009	63.000	2.110	0.450	1126.000	2.120	148.060
3567.819	63.000	2.010	0.290	1125.290	2.014	176.810
3523.565	63.000	2.160	0.360	1124.180	2.167	171.690
3473.710	63.000	2.080	0.420	1123.440	2.089	101.550
3428.117	63.000	2.380	0.280	1123.030	2.384	140.090
3367.181	63.000	2.250	0.900	1121.780	2.291	47.920
3287.910	63.000	1.860	0.530	1119.690	1.874	100.970
3248.861	63.000	2.920	0.390	1118.950	2.928	89.730
3191.016	63.000	1.400	0.610	1117.030	1.419	147.150
3117.710	63.000	1.770	0.370	1116.100	1.777	146.670
3062.852	63.000	1.270	0.530	1114.880	1.284	140.660
3003.901	63.000	1.950	0.430	1113.960	1.959	125.150
2939.320	63.000	1.850	0.540	1113.170	1.865	100.600
2866.932	63.000	2.240	0.360	1112.220	2.247	140.680
2797.762	63.000	1.620	0.570	1111.130	1.637	115.120
2724.568	63.000	2.080	0.520	1109.990	2.094	97.670
2651.589	63.000	3.800	0.340	1109.690	3.806	75.790
2584.027	63.000	3.890	0.510	1109.370	3.903	49.000
2519.219	63.000	2.710	0.800	1108.780	2.743	45.510
2454.766	63.000	2.730	0.760	1107.550	2.759	45.760
2405.041	63.000	2.530	0.800	1106.280	2.563	48.200
2336.775	63.000	2.810	0.490	1105.500	2.822	72.410
2291.798	63.000	3.310	0.370	1105.030	3.317	78.720
2238.046	63.000	1.910	0.610	1103.830	1.929	72.210
2181.979	63.000	2.720	0.580	1102.600	2.737	60.890
2122.331	63.000	2.360	0.620	1101.840	2.380	61.080

River Station	Flowrate	Flow Depth	Flow Velocity	Energy Level	Total Depth	Top Width
(-)	(m^3/s)	(m)	(m/s)	(m)	(m)	(m)
2058.724	63.000	3.810	0.420	1101.410	3.819	64.500
2012.177	63.000	3.510	0.520	1101.080	3.524	60.650
1962.634	63.000	3.470	0.490	1100.450	3.482	59.500
1915.813	63.000	2.450	0.890	1098.450	2.490	41.340
1856.996	63.000	3.610	0.510	1097.690	3.623	59.440
1800.188	63.000	3.240	0.510	1097.010	3.253	63.270
1738.519	63.000	2.990	0.410	1096.480	2.999	72.570
1683.727	63.000	1.720	0.630	1095.010	1.740	77.270
1645.382	63.000	1.840	0.690	1093.590	1.864	77.740
1605.203	63.000	1.850	0.360	1093.570	1.857	119.990
1559.949	63.000	1.840	0.410	1092.390	1.849	114.870
1518.195	63.000	1.980	0.450	1091.940	1.990	83.420
1455.266	63.000	2.820	0.370	1090.930	2.827	93.040
1406.743	63.000	1.550	0.580	1089.480	1.567	92.160
1338.188	63.000	2.970	0.300	1088.880	2.975	125.880
1253.007	63.000	1.330	0.880	1087.350	1.369	75.830
1196.506	63.000	2.600	0.360	1086.570	2.607	111.810
1138.518	63.000	2.190	0.380	1085.460	2.197	129.310
1071.329	63.000	2.030	0.410	1084.010	2.039	123.390
1008.141	63.000	2.490	0.550	1083.330	2.505	84.140
945.342	63.000	2.890	0.290	1082.800	2.894	136.770
918.741	63.000	1.050	1.110	1081.070	1.113	93.390
808.783	63.000	2.010	0.360	1079.930	2.017	136.780
761.558	63.000	1.780	0.330	1079.570	1.786	139.460
709.778	63.000	2.320	0.550	1078.320	2.335	66.670
649.210	63.000	3.080	0.490	1077.590	3.092	63.130
621.139	63.000	2.420	0.450	1076.210	2.430	101.250
546.346	63.000	3.480	0.720	1075.490	3.506	43.700
504.875	63.000	3.120	0.650	1074.660	3.142	48.890
421.181	63.000	3.280	0.410	1073.270	3.289	85.130
376.915	63.000	3.170	0.560	1072.090	3.186	53.490
340.665	63.000	2.540	0.880	1071.250	2.579	42.720
275.531	63.000	3.860	0.470	1070.560	3.871	64.450
227.213	63.000	3.130	0.580	1069.170	3.147	58.100
183.489	63.000	3.330	0.440	1068.710	3.340	75.090
134.435	63.000	3.020	0.550	1067.340	3.035	65.900
84.754	63.000	1.170	2.770	1065.250	1.561	29.470