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LEDA

ROOTED IN THE FUTURE

MUSINA-MAKHADO SPECIAL ECONOMIC ZONE DEVELOPMENT

FLOODLINE DELINEATION REPORT

FINAL REPORT
REVISION 00

SEPTEMBER 2020

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EXECUTIVE SUMMARY

Designated by the Department of Trade and Industry in July 2016, the Musina-Makhado Special Economic Zone (SEZ) comprises two sites. The southern site, situated approximately 34 km from the northern site, is a Greenfield site earmarked for the development of an energy and a metallurgical cluster for the production of high-grade steel. The southern site is the subject matter of this report and is located on eight farms overlapping the border between the Makhado and Musina local municipalities, within the Vhembe District Municipality. The essence of the Musina-Makhado SEZ is to create a new heavy industrial hub, which forms part of the Trans-Limpopo Spatial Development Initiative. The Musina-Makhado SEZ will attract foreign and domestic direct investment to promote industrial development.

Other land uses envisaged to complement the energy and metallurgical complex will comprise bulk infrastructure, light industries, intermodal facilities, housing, retail centres, business uses, community facilities and telecommunication services. In order to enable the development of the SEZ with all its land uses on the site, applications for environmental authorisation and change of land use must be submitted to the relevant competent authorities. Delta Built Environment Consultants (Delta BEC) was appointed by LEDA to execute these tasks, and as part of these tasks, Delta BEC was required to delineate the 50 and 100-year floodlines that could have an impact on the area.

This report outlines the methodology followed in delineating the floodlines as well as presenting the results obtained by Delta BEC following the evaluation. Delta BEC conducted the following tasks in the evaluation:

- Step 1: determine the centreline, left and right banks and connect the cross sections in a sequential manner.
- Step 2: determine if any junctions need to be specified (none was computed).
- Step 3: a Manning’s n value is determined for the channel, as well as the left and right overbanks.
- Step 4: hydraulic structures are added to the model as determined during the site investigation.
- Step 5: flow volumes computed in the run-off calculations are incorporated at specified cross sections.
- Step 6: reach boundary conditions are defined for sub-critical as well as super-critical flow conditions as a mixed flow analysis will be conducted.
- Step 7: a first round analysis is conducted on the model.
- Step 8: an iterative approach is followed to ensure that the flood analysis provides adequate results.
- Step 9: results from HEC-RAS are imported into Civil 3D and the analysed water level is delineated to present the delineated floodline.

The floodline is further certified in terms of the National Water Act, 1998 (Act 36 of 1998) and is presented in Appendix A of this report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

1 INTRODUCTION

1.1 BACKGROUND

The Musina-Makhado Special Economic Zone (SEZ) comprises of two sites. The southern site, situated approximately 34 km from the northern site, is a Greenfield site earmarked for the development of an energy and a metallurgical cluster for the production of high-grade steel. The southern site is located on eight farms overlapping the border between the Makhado and Musina local municipalities, within the Vhembe District Municipality. The essence of the Musina-Makhado SEZ is to create a new heavy industrial hub which forms part of the Trans-Limpopo Spatial Development Initiative.

In order to enable the development of the SEZ with all its land uses on the site, applications for environmental authorisation and change of land use must be submitted to the relevant competent authorities. Delta BEC was appointed by LEDA to execute these tasks, and as part of these tasks Delta BEC was required to delineate the 50 and 100-year floodlines that could have an impact on the area.

1.2 PURPOSE OF REPORT

The purpose of this report is to put forward the 50 and 100-year recurrence interval floodlines delineated by Delta BEC. The report outlines the methodology used in determining the findings made, as well as certifying and presenting them.

1.3 STRUCTURE OF REPORT

The report is structured as follows:

- Section 2: Project Locality
- Section 3: Methodology
- Section 4: Results
- Section 5: Conclusion.

2 PROJECT LOCALITY

The Department of Trade and Industry evaluated the submission and approved two of the areas for further feasibility investigation including Musina and Tubatse. The provincial government subsequently motivated that the proposed Musina SEZ will include two components/sites situated at two different locations. The site in proximity to Musina Town targets light industrial and agro-processing clusters amongst others, and the southern site a metallurgical/mineral beneficiation complex. The two developments will complement each other in terms of its respective product value chain and logistics. The focus of this project will be specifically on the southern part of the Musina-Makhado SEZ focusing on the metallurgical cluster as shown in Figure 2-1.

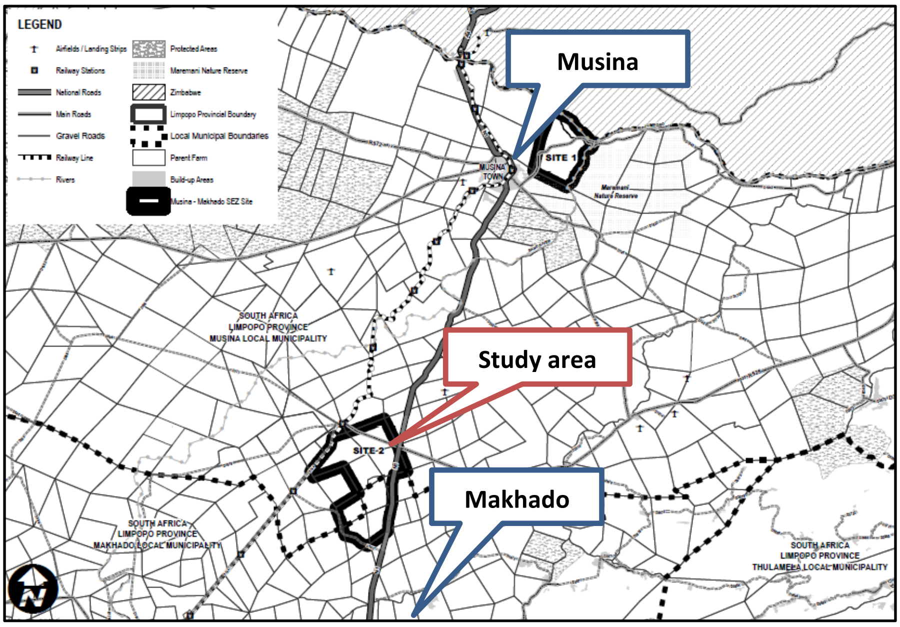

Figure 2-1: Musina-Makhado SEZ locality

3 METHODOLOGY

This chapter provides a brief summary of the methodology followed by Delta BEC in delineating the flood levels for the 50 and 100-year recurrence intervals.

3.1 DESKTOP STUDY

As a starting point, Delta BEC has reviewed the existing information in order to establish a design methodology. This included status quo and existing hydrological and topographical information.

3.2 ESTABLISH TOPOGRAPHY AND LAND COVERAGE

Once the desktop study was completed, Delta BEC conducted a visual inspection of the catchment area in order to establish the predominant veld coverage. Delta BEC also established that the area falls within Drainage Basin 3 outlined in the Drainage Manual (van Vuuren, et al., 2013). This drainage basin is used in the computation of the Standard Design Flood Method (SDF).

3.3 DELINEATE CATCHMENT AREA AND LONGSECTION WATER PATH

Delta BEC considered different run-off computation models such as the SDF, rational and empirical models and as such, required certain user input parameters in order to calculate run-off volumes.

As a starting point, Delta BEC delineated the catchment area as well as the longest water path. The following definitions are given to the parameters:

- *Catchment area*: square metre area contributing stormwater run-off to the point of evaluation, measured in square kilometres.
- *Longest water path*: the longest path that a drop of water will undertake to contribute to the point of evaluation.

The aforementioned delineated parameters are illustrated graphically in Figure **3-1**.

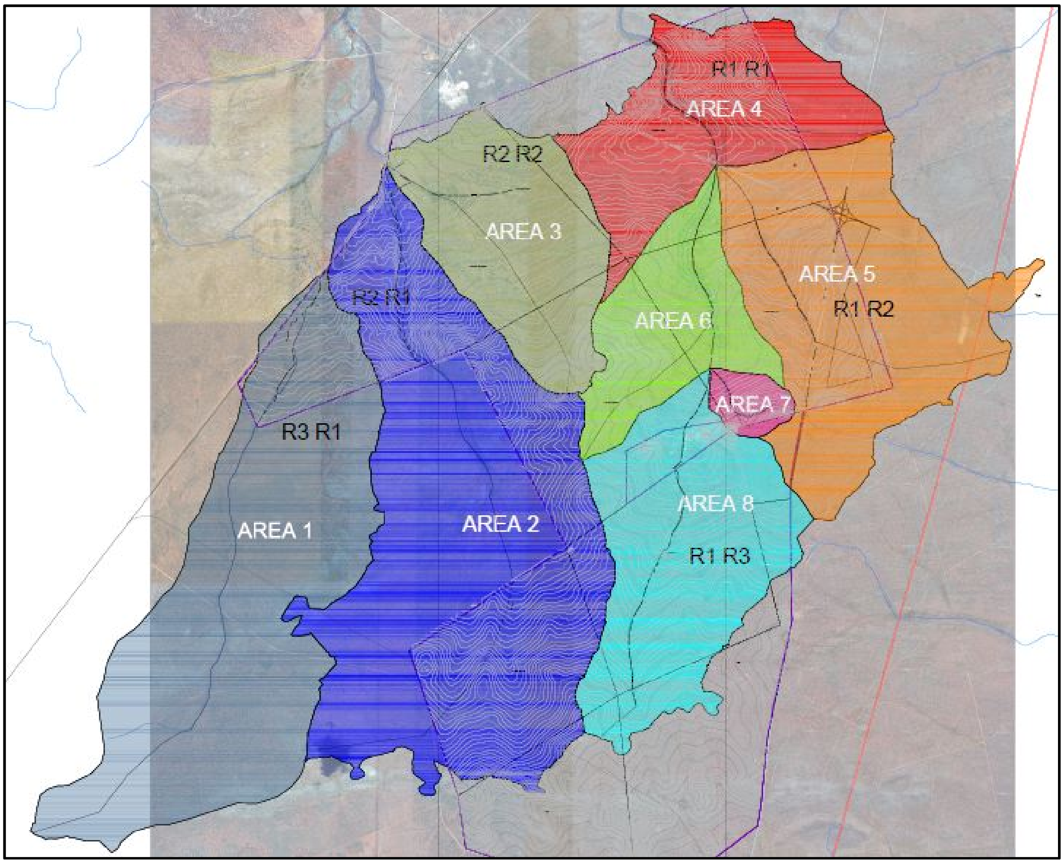

Figure 3-1: Catchment delineation

3.4 CALCULATE RUN-OFF VOLUMES

Various flood magnitude-frequency relationships are used in South Africa. The drainage manual published by the South African National Roads Agency (SANRAL) provides criteria for when such relationships can be used as all the methods make certain assumptions. Based on the size limitation of other methods, Delta BEC used the Standard Design Flood method (SDF).

3.4.1 STANDARD DESIGN FLOOD METHOD

The SDF was proposed by Alexander (2002) as a way to limit the impact of the user on the output results. The method aims to provide an easy to use computation model, which can be used by various users while providing similar results. The input requirements derived by Delta BEC are summarised in Table **3-1**.

Table 3-1: SDF input requirements

Input Requirement	Value
Basin as per the drainage manual	3
Total Catchment area (km^2) – including all areas	113.808
Total Longest Water Course (km) – including all areas	54.081
Average Slope (m/m)	0.008

3.4.2 RESULTS

The results obtained from the SDF computation are summarised in Table 3-2. These areas refer to Table 3-1.

Table 3-2: Peak flow volumes

Area	50 year (m^3/s)	100 year (m^3/s)
Area 1	99.08	127.58
Area 2	120.83	155.59
Area 3	72.17	92.93
Area 4	62.68	80.72
Area 5	95.75	123.30
Area 6	44.81	57.70
Area 7	15.42	19.85
Area 8	76.45	98.44

3.5 FLOODLINE DELINEATION

In order to compute a flood analysis, Delta BEC made use of two software packages, namely:

- Autodesk Civil 3D
- Hydrologic Engineering Centre's River Analysis System (HEC-RAS).

The Natalspruit system was incorporated into Civil 3D by extracting cross sections at a specified interval. The cross sections were initially spaced by using the following formula:

- $Spacing = 0.15 \times \frac{Bank\ Depth}{Bed\ Slope}$

A sensitivity analysis was conducted on the spacing to determine influence, so to ensure that spacing provided realistic results. Cross section extraction was done in Civil 3D after which hydraulic analysis was done on the HEC-RAS software. The analysis conducted in HEC-RAS can be summarised as follows:

- **Step 1**: determine the centreline, left and right banks and connect the cross sections in a sequential manner.
- **Step 2**: determine if any junctions need to be specified (none was computed).
- **Step 3**: a Manning's n value is determined for the channel, as well as the left and right overbanks.
- **Step 4**: hydraulic structures are added to the model as determined during the site investigation.
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- **Step 7**: a first round analysis is conducted on the model.
- **Step 8**: an iterative approach is followed to ensure that the flood analysis provides adequate results.
- **Step 9**: results from HEC-RAS are imported into Civil 3D and the analysed water level is delineated to present the delineated floodline.

The results obtained in HEC-RAS are illustrated in Figure 3-2, as typical cross section is also presented in Figure 3-3.

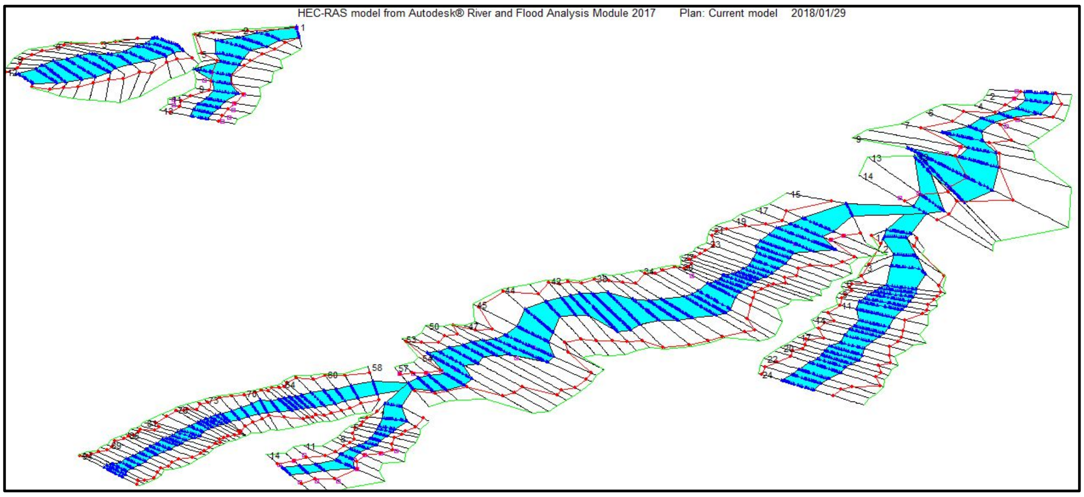

Figure 3-2: X, Y, Z plot of delineated flood levels

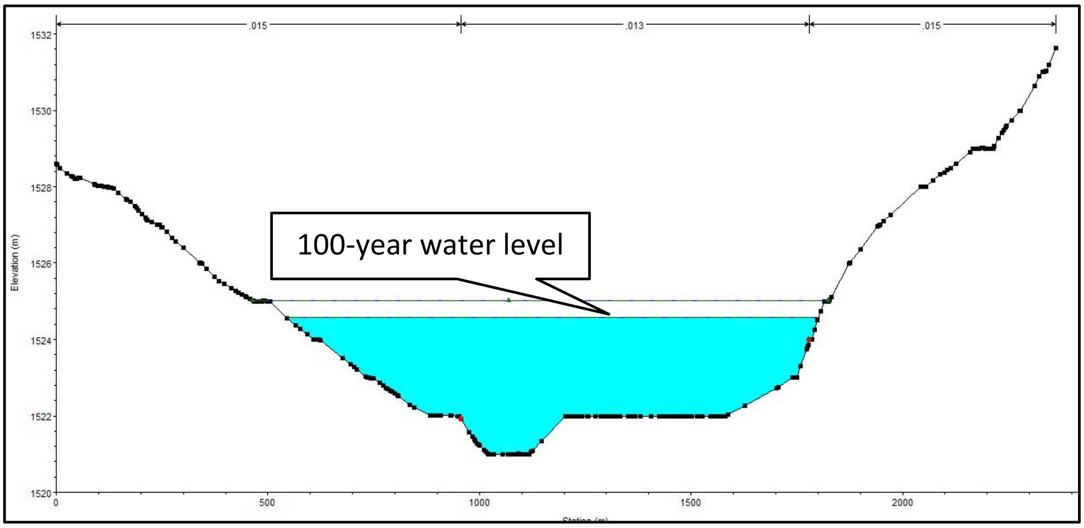

Figure 3-3: Typical cross section (HEC-RAS)

4 RESULTS

4.1 FLOODLINE

The 50 and 100-year flood lines were extracted from HEC-RAS by using Autodesk Civil 3D. The flood lines are then represented by the maximum water level generated by the cross sections specified in the design. The results are depicted in Figure 4-1.

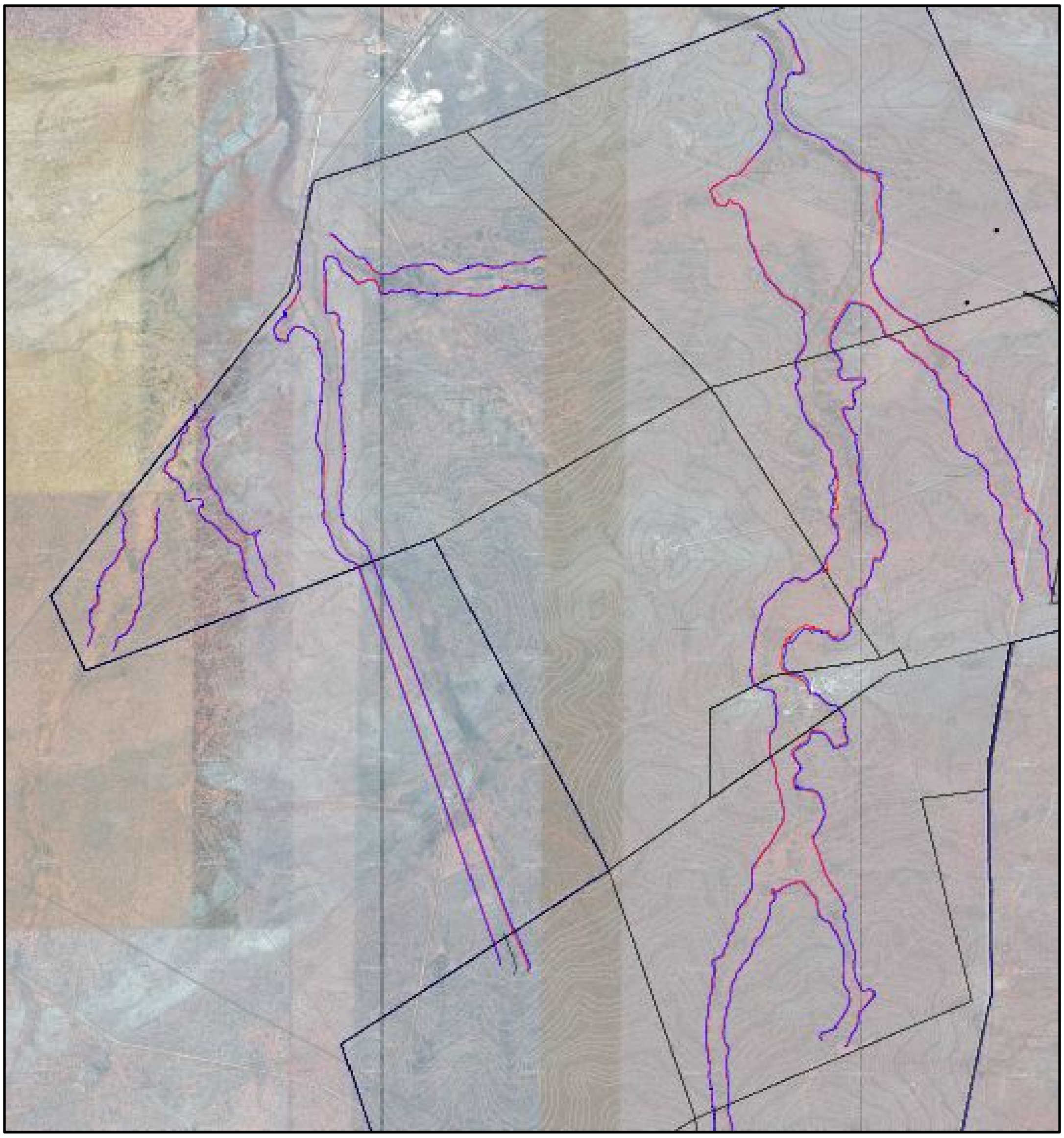

Figure 4-1: 50 and 100-year delineated flood lines

5 CONCLUSION

Delta BEC has concluded the delineation of the 50 and 100-year floodlines and has compiled such drawings both in soft and in hard copy for submission to LEDA. This report is read in conjunction with the appendices attached to the report, namely:

- Appendix A – Certified floodlines
- Appendix B – Catchment areas.

The floodlines presented in this report are certified in accordance with the National Water Act, Act 36 of 1998 and presents the flood levels which can occur during a 1 in 50 and 1 in 100 year storm respectively. This does however not indicate that it will occur every 50 or 100 years as the recurrence intervals indicate a probable occurrence.

Some construction work can be done to limit the extent of the flood levels, as is evident at road crossings where large scale damming is visible. The floodline analysis has to be re-evaluated when construction works has commenced in the area to ensure that no adverse effects occur either upstream or downstream of the project area.

APPENDIX A: CERTIFIED FLOODLINES

APPENDIX B: CATCHMENT AREA