NELSON MANDELA BAY MUNICIPALITY

AMENDED STORMWATER MANAGEMENT PLAN

PROJECT NAME:	**GQEBERA TOWNSHIP DEVELOPMENT: ERF 11305 TRANSIT AREA**
AREA:	**NELSON MANDELA BAY MUNICIPALITY**
PROVINCE:	**EASTERN CAPE**
DATE:	**SEPTEMBER 2017**

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NELSON MANDELA BAY METROPOLITAN
GQEBERA TOWNSHIP DEVELOPMENT: ERF 11305

Document Change History

Revision	Date	Changes	Approval
	19/09/2017	Amendment to item 5.2 and safety measures	

The Amended Stormwater Management Report was:

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Reviewed by	:	M Hallowes	**Position**	:	Manager	**Signature**	:
Approved by	:	B O'Connell	**Position**	:	Engineer	**Signature**	:

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1. EXECUTIVE SUMMARY

This Amendment deals with a re-wording of the item 5.2 'Major System' and includes a minor aspect related to safety i.e. the necessity for fencing the proposed ponds on site.

The proposed project entails the development of mixed typology housing with associated facilities and infrastructure, on an undeveloped 43.74 ha site in Walmer Gqebera on Erf 11305. The development aims to cater for the overflow of residents currently living in informal settlements in the Walmer Gqebera area. The provision of civil engineering services includes roads, storm water, sewerage, water supply and construction of an estimated 1700 housing units, along with associated community facilities. The Amended Scoping Report (AFSR) was done by SRK and sent on the 26/03/2016 to DEDEA. The department required that stormwater mitigation measures for the run-off to be provided for the development to be approved as stated in the letter ECm1/C/LN2/15/39-2014 dated 19/05/2016.

This report has been prepared to inform the EIA process on what storm water mitigation measures will be provided for Erf 11305.

In the absence of a municipal stormwater management policy or guidelines, the *Guidelines for Human Settlement and Design* have been used. The minor drainage system of 1:5-year recurrence interval will be controlled through the use of piped stormwater system, while the major drainage system of 1:50-year recurrence interval will be controlled through use of open channels, detention ponds and the road system. During construction, stormwater will be managed through use of temporary ponds and berms.

2. INTRODUCTION

2.1 BACKGROUND

Makhetha Development Consultants were appointed by the Nelson Mandela Bay Municipality to provide civil engineering services for the proposed housing development in Erf 11305 Walmer Gqebera. The services included roads, water supply, sewerage and stormwater. The project entails construction of an estimated 1700 housing units, on a 43.74 ha site. The Amended Final Scoping Report (AFSR) was undertaken by SRK. The department required that stormwater mitigation measures for the run-off to be provided for the development to be approved as stated in the letter ECm1/C/LN2/15/39-2014 dated 19/05/2016. Amongst the project specific conditions was that "A detailed stormwater management plan to address increased sediment load in storm water runoff, caused by vegetation clearance, is to be submitted to the department for approval prior to construction commencing"

This report has been undertaken by Makhetha Development Consultants as they were involved in the design of stormwater.

2.2 PRINCIPAL OBJECTIVES

The principal objectives of this report are;

- To provide a design basis for the proposed storm water management with respect to water quantity.
- To ensure compatibility of the site with relevant legislation from a surface water perspective.
- To recommend mitigation measures in managing increased concentrated flows as a result of the proposed development.
- To provide ways to regulate and monitor how the storm water will be managed during construction.

3. LEGAL REQUIREMENTS

The goal of storm water management is to lessen the impact of storm water flow through and off developed areas. The surface water management for the proposed development and related infrastructure falls under legislation contained in, amongst others, the National Water Act (36 of 1998) (NWA). The enforcing authority is the Department of Water affairs and Sanitation (DWAS). The Local Municipality generally controls the provision of water. The provision of the act is thus aimed at discouraging pollution and waste of water resources. Chapter 3 Part 4 (Section 19) deals with prevention of pollution. It states that any person who owns, control or uses the land is responsible for taking measures to prevent pollution of water resource.

The act also defines water use as the abstraction, consumption and discharge of water. Use of water includes the discharge of water containing waste into a water resource and the disposal of water containing waste from an industrial process in any manner.

4. STORMWATER MANAGEMENT

Storm water management involves the effective handling of the quantity and quality of runoff water being discharged into a land or water area. Effective management requires that possible pollution conditions of storm water be addressed adequately as these impact water bodies downstream. Also, erosion and sedimentation assert a detrimental impact on the existing drainage as the deposited silt and soil particles render the drainage incapable of operating at original designed level.

Best Management Practices (BMPs) are then suggested to reduce or to possibly eliminate the detrimental impacts resulting from uncontrolled erosion and sedimentation from the land upstream.

5. PROPOSED STORMWATER DRAINAGE SYSTEM

Storm water systems are categorised into two systems, namely major and minor systems. These storms are accommodated into different systems: the minor storm is usually accommodated in pipe systems because the catchment areas are relatively small and usually produce relatively low peak run-off and major storm catchment areas are usually large and therefore usually produce high peak run-off and are usually conveyed by roads and channels.

Although run-off calculations are performed as accurately as possible, non-hydrological reasons can cause the capacity of a storm water system to be exceeded. There are limits set to the elimination of probabilities in order to prevent costs from being unrealistically high, in comparison with the benefit of the lower costs.

Although the relationship between function, risk, original cost and maintenance cost plays a major role in determining the design flood frequency, it is assumed in general that the flood frequencies should be provided for under normal circumstances.

The applicable analysis; assessment and design standards used were those given in table 6.1 and 6.2 of *The Guidelines for Human Settlement Planning and Design* are as follows:

Table 7.1: Typical storm water analysis requirements based on land-uses

LAND USE	DESIGN FLOOD RECURRENCE INTERVAL (Major Storm Events)
Residential	50 years
Institutional (e.g. schools)	50 years
General commercial and industrial	50 years
High value central business districts	50 - 100 years

Table 7.2: Typical storm water analysis requirements based on land-uses

LAND USE	DESIGN FLOOD RECURRENCE INTERVAL (Minor Storm Events)
Residential	1 – 5 years
Institutional (e.g. schools)	2 – 5 years
General commercial and industrial	5 years
High value central business districts	5 - 10 years

5.1 MINOR SYSTEM

The primary goal of minor systems is to quickly remove water emanating from a minor storm of 1:5-year recurrence interval, to ensure convenience of nearby residents and the safety of traffic during normal rainfall. The proposed development stormwater drainage system should be able to handle infrequent severe storms (major storms) and frequent minor storms. According to CSIR (2000), the typical formal drainage system should be able to handle the minor storms and during the major storms should support the major drainage system in handling the unusual storm.

The minor system usually consists of road drainage channels and kerbs, kerb inlets, grid inlets, manholes, pipes, and small open channels for rapid discharge of run-offs. The preliminary sizing of the facilities is determined on the basis of short duration, high intensity storms taking into account concentrated flow entering a minor system.

5.2 MAJOR SYSTEM

The main purpose of the major system is to convey and control large floods of 1:50-year recurrence interval. The use of attenuation ponds is an effective means of attenuating flood peaks. This helps with reducing excessive sizes of culverts and channels by reducing peak to manageable levels. Thus, development of new areas should attempt to attenuate storm water within the developments, before releasing it into a municipality system. However, it is sometimes not cost effective because they sometimes require substantial structural measures. Major floods can be controlled by roads, park strips without putting attenuation ponds in place. However, ponds have been provided on site as requested by DEDEAT.

Three Major catchment areas have been identified for the proposed development. Three on-site attenuation ponds have been provided for the three major catchment areas as per DEDEAT requirements. Three main roads have been identified to convey the major storm to the proposed ponds.

The principle design for the proposed on-site Pond 1 can be summarised as follows:

- Capacity : 1502.00m³;
- Footprint Area : 2700.00m² (Includes required construction space);
- Pond Average Depth: 1.46m;
- Max. Water Depth : 0.596m;
- Total Cut : 2245.00m³
- Total Fill : 0.00m³;
- Inlets : Overland runoff in-flow;
- Outlets : 525mm Ø concrete pipe.

The principle design for the proposed on-site Pond 2 can be summarised as follows:

- Capacity : 1331.00m³;
- Footprint Area : 1700m² (Includes required construction space);
- Pond Average Depth: 2.40m;
- Max. Water Depth : 0.817m;
- Total Cut : 2441.939m³
- Total Fill : 0.00m³;
- Inlets : Overland runoff in-flow;
- Outlets : 525mm Ø concrete pipe.

The principle design for the proposed on-site Pond 3 can be summarised as follows:

- Capacity : 7598.000m³;
- Footprint Area : 3800.00m² (Includes required construction space);
- Pond Average Depth: 4.20m;
- Max. Water Depth : 2.054m;
- Total Cut : 11357.692m³
- Total Fill : 0.00m³;
- Inlets : Overland runoff in-flow;
- Outlets : 525mm Ø concrete pipe.

The ponds were initially designed to discharge via a 525mm Ø outlet into stormwater reticulation that would eventually connect to the existing municipal system along Victoria Drive.

On checking this option with JG Afrika the designers of the stormwater master plan, their response [see Appendix B] was that the direct connection from the site to the pipe system now installed in Victoria Drive would not handle the proposed flows from the site.

However, a storm water pond has also been provided as part of the master plan in the north-eastern side to attenuate major storm from the site and is currently under construction. This is the only economically viable alternative to piping the stormwater discharged from the site for several kilometres.

The principle design for this Detention Pond can be summarised as follows:

- Capacity : 18300.00m³;
- Footprint Area : 22520.00m² (Includes required construction space);
- Pond Depth : 4.15m;
- Max. Water Depth : 3.15m;
- Total Cut : 36,625m³
- Total Fill : 235m³;
- Inlets : Overland runoff in-flow;
- Outlets : 525mm Ø concrete pipe.

This is therefore the recommended discharge point for stormwater piped from Erf 11305.

5.3 DESIGN CRITERIA

The proposed storm water routes for the proposed development were analysed for run-off of a 1:5 and 1:50-year recurrence intervals, assuming that the area is fully developed as per layout plan.

The following approach and criteria was used in carrying out the drainage system design analysis:

- The principle of overflow was applied to roadways which were designed and graded to avoid concentration of flow along and off the road.
- All streets will be provided with kerb and channel and kerb inlets.
- Inlets have been designed to ensure that the capacity of any given culvert does not exceed the pre-development storm water flow at any particularly point.
- Outlet structures at road culverts have been designed in a manner that dissipates flow energy.

5.4 PARAMETERS

The percentage imperviousness of each sub catchment is related to its particular type and density of development. A percentage imperviousness of 70% for the development was established based on houses and roads to be built on the development.

A summary of the various parameter values used in the simulation modelling of overland roughness coefficient is given below:

- House/Ervens = 0.5
- Parks = 0.2
- Streets = 0.7

5.5 HYDROLOGY

5.5.1 Rainfall Data Intensity

The project area is in a moderate climatic region with approximate Weinert values of 2 – 5. The annual rainfall is 600-800mm.

The rainfall data was determined as per IDF curves. The annual rainfall is between 600-800mm. A mean annual rainfall (MAP) of 632mm was used for hydrology calculations. The following equation was used to determine the peak intensity of the storm for each catchment area:

$I = a/ (b + t)^{c}$

I = Intensity (mm/hr)

a = Mean Annual precipitation (mm)

b = constant based on local conditions

t = duration (minutes)

c = constant based on local conditions

Where:

$I_{5years} = 632/ (10 + t)^{0.7}$
$I_{50years} = 859/ (7 + t)^{0.643}$

5.5.2 Run-Off calculations

A 1:20 000 orthophoto image was used to ascertain and identify hydrological conditions and requirements for drainage structures. The hydrological data for return period 1:5-year flood events was generated for each catchment area using the rational Method.

The storm water catchment areas were determined using 1m contours from the 1:10 000 plans. This area was first divided into major catchment areas and then was divided into several small catchment areas to calculate the individual flows that contribute to the pipe culverts. In the preparation of sub-catchment area boundaries, account has been taken of the natural watershed and the probable impact of proposed roads on the flow of storm water run-off. Certain sub-catchments were defined by proposed roadways likely to concentrate storm water run-off in a formalized system

The general norm is that storm peak flow run-off may be computed for small catchments (up to (15km^2) by means of the Rational method. There were no catchment areas greater than 15km^2 so the rational method used to determine run-off for each catchment area. The latest software from the Civil Designer computer programme, called ‘Storm’, was utilised in modelling run-offs from the study area and the hydraulic analysis was also undertaken utilising the Civil Designer computer programme.

6. HYDRAULICS

6.1 PEAK DISCHARGE FLOWS

Preliminary designs for the expected discharges were calculated. Storm durations of 30 minutes were assumed for the calculation of peak discharges. The expected discharges for a recurrence interval of 1:5-year for the different catchment areas were determined by means of the Rational Method.

A soccer field and open spaces within the development have been identified to be used for detention ponds. No additional trapped low points are foreseen hence no additional servitudes are anticipated.

6.2 PIPED DRAINAGE

A minimum pipe size of 450mm diameter and class D with a minimum slope of 1:100 for minor drainage is proposed for the development. The recommended minimum pipe cover is 800 mm around the developable sites and 1.0 m elsewhere in the development. The minimum pipe velocity of 0.9m/s was adopted in order to prevent siltation.

6.3 OPEN DRAINAGE

An open channel is proposed on the north-eastern side of the development to convey both minor and major storm into the vacant golf course land and eventually into the adjacent pond situated in the Golf course area. The kerb channels along the road have been sized to convey a 1:5-year recurrence interval with a 90mm freeboard. The open channel to convey the minor and major storm in the development was designed for 1:50-year recurrence interval. The recommended minimum and maximum velocities in the channels are 0.9 m/s and 3.0 m/s respectively.

It is proposed that the open channel must be constructed with concrete within the development and with ‘armorflex’ in the golf course area due to costs and environmental consideration. The concrete side slopes of the channels will be maximum 1:2 and armorflex sides slope will be 1:3 maximum and the minimum channel bed slope will be 1:500.

7. OPERATIONS AND MAINTENANCE

Once the storm water facilities have been completed, and fenced to prevent access by the public, the maintenance and monitoring will remain the responsibility of the municipality. These are some of the suggested Best Management Practices (BMPs) for the development;

- Public open space – Vegetation to be maintained such that flood water levels are not increased.
- Storm water structures – Ponds frequently monitored and obstructions (debris) to inlet/outlet works, removed.
- Open Channels – Channels to be regularly monitored to identify any erosion gullies or silt deposition.
- Road Construction – No concentrated flow points are allowed onto road area.

- Pipes – All pipes are to be frequently monitored and cleared of obstructions.

8. CONCLUSION AND RECOMMENDATION

The area can be developed without the risk of flooding. In the absence of the municipal-specific guidelines for the management of stormwater, the *Guidelines for Human Settlement Planning and Design* has been used.

It is recommended that the development be implemented according to the processes that have been mentioned above.

APPENDIX A

Erf 11305 GENERAL LAYOUT: STORM WATER MANAGEMENT PLAN

APPENDIX B

EMAIL FROM JG AFRIKA RELATING TO PIPED DISCHARGE

Mark Hallowes

Subject: FW: Walmer Stormwater

From: Hendrik Spangenberg [mailto:SpangenbergH@jgafrika.com]
Sent: 18 September 2017 16:43
To: lethu@makhetha.co.za
Cc: Mthuthuzeli Gqokoma <GqokomaM@jgafrika.com>
Subject: RE: Walmer Stormwater

Lethu

Your email below with regard discharging stormwater into existing stormwater pipes along Victoria drive refer.

The following is noted:

- The outflow pipes installed under contract SCM/15-59/S along Victoria drive vary from 450mm dia. to 750mm dia.
- The last downstream pipe along this stormwater pipe line, immediately prior to discharging into a pond near Buffelsfontein road, is 750mm dia. pipe with a slope of approximately 1.3%.
- The maximum gravity free flow(no surcharge) in a 750mm dia. pipe at 1.3% slope is approximately 1.2m^3/s.
- Your capacity required 2.02 m^3/s.
- Therefore, irrespective of any existing upstream pipe sizes and slopes, the required capacity cannot be accommodated in the last downstream 750mm dia. pipe under free flow(no surcharge) conditions.

You are welcome to discuss the above at our offices should you require any further clarity.

We trust the above is in order.

Kind regards

Hendrik Spangenberg **Pr Tech Eng**
Technologist
Municipal Infrastructure

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