

ROBERTSON STORMWATER MASTER PLAN UPDATE

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ROBERTSON

STORMWATER MASTER PLAN

UPDATE

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1 TERMS OF REFERENCE

Jeffares & Green (Pty) Ltd was appointed in 2007 by the Breede River Winelands Municipality to develop a Stormwater Master Plan (SWMP) for Robertson. The focus of the exercise was on the condition and performance of the existing underground stormwater infrastructure. Consequently, Nkqubela was not included in the study to any significant extent.

This report is a standalone document that is an update of the 2007 SWMP and is intended to be read in conjunction with the original document. The main purpose of this update is to address the management of stormwater in the Nkqubela area.

This update also incorporates revised cost estimates for the interventions recommended in the 2007 SWMP.

2 SITE INVESTIGATION

A site investigation was conducted on the 16th of January. In addition to a visual inspection of the stormwater system, discussions were held with municipal officials and residents to identify the main issues affecting the functioning of the system. These are highlighted in **Section 5**, below.

3 DESCRIPTION OF STUDY AREA

Nkqubela is situated on the southern side of the R60 as indicated in Error! Reference source not found. in **Appendix A**. The current developed area covers approximately 60 hectares.

4 EXISTING STORMWATER INFRASTRUCTURE

All stormwater runoff is currently routed aboveground via the internal streets and preferential drainage paths. There are numerous lined and unlined channels as well as culverts beneath existing streets that cross the channels. The existing aboveground stormwater infrastructure is shown in Error! Reference source not found. in **Appendix A**.

5 GENERAL ASSESSMENT & IDENTIFIED ISSUES

Nkqubela has been developed on a moderately steep terrain (average slope 2 to 5%). The area receives stormwater runoff from the steep mountainous terrain to the west/south west of the development area (average slope 10 to 30%). The runoff from the east/north east is constrained by the railway line and the R317 roadway and does not have a significant effect on Nkqubela. The stormwater runoff in Nkqubela follows the preferential drainage paths through the development and is discharged towards the south east.

The capacity of the aboveground system is constrained by the cross-sectional geometry of the open channels and the street side-drains.

Newly formal housing has been constructed in the area immediately west of Nkqubela (See Error! Reference source not found. in **Appendix A**). Cadastral information for this area was not available. However, the area was assessed during the visual site inspection. Stormwater runoff from this newly developed area is conveyed in a northerly direction towards the formal



stormwater infrastructure in the industrial area and does not affect the portion of Nkqubela that discharges southwards.

Two areas of localised flooding were identified during the visual inspection. These are shown as B and C on Error! Reference source not found. in **Appendix A**. Points A and D were also identified as points of interest from a hydraulic modelling perspective. These are also indicated on **Figure 3**.

The stormwater discharged southwards from Nkqubela was also identified as an issue. This water collects in an irrigation canal used by local farmers. The quality of the stormwater could have a detrimental effect on the downstream water users and peak flows during high-order storm events may cause damage to downstream infrastructure.

5.1 Stormwater Issue 1

During the visual site inspection, officials from the Langeberg Municipality reported that the houses at the south eastern boundary of Nkqubela regularly overflows during significant storm events. The officials indicated that the streets overflow and flood the surrounding houses. The location of Stormwater Issue 1 is shown as Point B in Error! Reference source not found. in **Appendix A**.

5.2 Stormwater Issue 2

During the visual site inspection, discussions with residents of Nkqubela indicated that the open undeveloped space (Point C in Error! Reference source not found. in **Appendix A**) regularly overflows into the properties to the north east of Point C during significant storm events. This area has been highlighted as a second area of concern.

5.3 Stormwater Issue 3

During the visual inspection, it was confirmed that the stormwater discharging southwards from Nkqubela is routed into an irrigation canal (south of Point A in Error! Reference source not found. in **Appendix A**) via an informal pond. There is no formal infrastructure to control the rate of flow or the quality of runoff.

6 STORMWATER MODELLING

6.1 Hydrology

For purposes of continuity, the same hydrological parameters and design rainfall events from the 2007 study were used. These are listed in **Appendix B**.

The following design storm depths were used for modelling purposes:

Table 1: Design storm depths per return period

Station	Name	Location		M.A.P (mm)	Design depth (mm)	
		Deg S	Deg E		T = 2 years	T = 50 years
0023619 W	ROBERTSON (MUN)	33°48'	19°52'	381	32	89



6.2 Hydraulic modelling

A model of the study area was set up using EPA SWMM 5.1 (United States Environmental Protection Agency Storm Water Management Model, Release 5.1.002).

The hydraulic modelling was based on regional contours with a contour interval of 5m. No detailed as-built information of the existing municipal civil infrastructure was used. The hydraulic models were set up using data gathered during the site investigation and a desktop review of the available information. Where necessary, reasonable assumptions regarding the following were made:

- Street cross-sections;
- Preferential drainage routes; and
- Condition of infrastructure.

Twelve separate stormwater sub-catchments were identified during the desktop review of the study area. The proposed sub-catchments represent the extent of the entire study area and are shown in Error! Reference source not found. in **Appendix A**.

This desktop review allowed the design team to establish the likely stormwater response of the township. However, it must be noted that the modelling corresponds to the level of detail of the available data. The analysis is therefore high-level in nature.

Three hydraulic models were set up and analysed for the 2 year and 50 return periods. The three scenarios are as follows:

6.2.1 Scenario 1: Pre-development Scenario

This model computes the peak stormwater flows discharging downstream of the study area before the development of Nkqubela.

6.2.2 Scenario 2: Post-development Pre-Intervention Scenario

This model represents the status-quo of the study area. Scenario 2 computes the peak stormwater flows at four points of interest. Points B and C represent the stormwater conveyance issues highlighted in **Section 5**.

6.2.3 Scenario 3: Post-development Post-Intervention Scenario

This model represents the study area after the construction of recommended short-term mitigation measures presented in **Section 8**. Scenario 3 computes the peak stormwater flows at the same points of interest analysed in Scenario 2 and indicates the anticipated effects of the short-term mitigation measures.

6.3 Analysis

The modelled peak flows at the four points of interest for scenarios 1 to 3 are shown in **Table 2**, below:



Table 2: Peak Stormwater Flows

Point of Interest	PRE-DEVELOPMENT		POST-DEVELOPMENT			
	SCENARIO 1 (Pre-Development) Peak Flow (m ³ /s)		SCENARIO 2 (Pre-Intervention) Peak Flow (m ³ /s)		SCENARIO 3 (Post-Intervention) Peak Flow (m ³ /s)	
	T = 2 years	T = 50 years	T = 2 years	T = 50 years	T = 2 years	T = 50 years
A	1.02	6.80	2.24	10.47	2.04	9.51
B	-	-	0.49	2.65	0.29	1.20
C	-	-	1.33	5.45	1.03	4.63
D	-	-	0.61	2.58	0.46	1.99

The contributing stormwater sub-catchments for the discharge points for scenarios 1 to 3 are listed in **Table 3**, below:

Table 3: Contributing Stormwater Sub-Catchments

	Contributing Sub-Catchments for Discharge Points			
	A	B	C	D
SCENARIO 1	All	-	-	-
SCENARIO 2	All	SC2; SC3; SC6	SC4; SC5; SC7; SC8	SC4; SC5; SC7; SC8; SC9; SC11; SC12
SCENARIO 3	All	SC6	SC4; SC5; SC7; SC8	SC4; SC5; SC7; SC8; SC9; SC11; SC12

6.4 Calibration

No correlated rainfall / flow data was available to permit calibration of the models. However, order-of-magnitude cross-checks were carried out using deterministic methods and the modelled results were found to be reasonable.

7 MANAGEMENT OF STORMWATER IMPACTS

7.1 Design standards

The Langeberg Municipality does not have a specific stormwater management policy. Consequently, the following standards (partly based on the City of Cape Town's 2009 *Management of Urban Stormwater Impacts Policy*) are recommended:

- Runoff from storm events up the 10-year Return Period reduced to pre-development levels;
- Natural groundwater recharge to be encouraged;
- Litter, oil and grease to be removed at source;
- Settleable solids to be reduced by 80% for the half-year Return Period 24 hour storm;

7.2 Detention storage

Formal detention storage will assist with mitigating storm water impacts arising from both conveyance and water quality issues. See **Section 8** for recommendations regarding the provision of detention storage ponds.

7.3 Channels and berms

Localised flooding can be mitigated through the provision of strategically placed berms and channels to facilitate more effective stormwater conveyance. See **Section 8** for recommendations regarding the provision of additional conveyance structures.

7.4 Water quality improvement

The three primary pollutants in the stormwater runoff from Nkqubela are grit, litter and biological nutrients. Several interventions will be necessary to improve the quality of stormwater discharged downstream.

Removal of grit can be achieved via a grit trap. The efficiency of the trap is dependent on its size – larger traps are more efficient. Consequently, a balance needs to be struck between affordability and efficiency. It requires periodic maintenance and ad-hoc removal of accumulated material.

Removal of litter can be achieved via a litter trap, but non-mechanical traps are subject to the constraint that they are only effective when there is adequate hydraulic head between the inlet and the outlet. This is often difficult to achieve in existing stormwater networks. Regular maintenance is required and removal of accumulated litter is necessary after each rainfall event, otherwise the wet material can become a health hazard.

The most effective means of removing biological nutrients would be to route the runoff through a vegetated bio-retention area or swale. Such a facility would require regular watering and maintenance to ensure that it functions as designed. Furthermore, a swale requires periodic rehabilitation as its effectiveness reduces over time. It is therefore a relatively management-intensive intervention that needs to incorporate a comprehensive long-term maintenance strategy.

A less effective way to remove nutrients is by means of an infiltration basin, where the bulk of the runoff is retained long enough to allow significant infiltration to take place. This intervention is dependent on the permeability of the underlying soil layers with respect to the available space for construction.

8 RECOMMENDATIONS

The proposed mitigation measures are outlined below and are shown on Error! Reference source not found. in **Appendix A**. For consistency, the numbering of the proposals is in line with the numbering used in Table F.1 of the 2007 report and therefore commences at 33.

A revised Table F.1, with updated costs and the mitigation measures proposed in this report, has been included in **Appendix C**.

The mitigation measures are split into two priorities, namely, urgent and long-term.



8.1 Urgent mitigation measures:

It is recommended that these mitigation measures be carried out immediately to reduce the localised flooding highlighted in **Section 5**. These measures focus on stormwater conveyance only and will not have a significant effect on water quality. The mitigation measures and their locations are summarised in **Table 4**.

Table 4: Urgent Mitigation Measures (Conveyance Issues Only)

Item	Description of Intervention
33	Construct a 160m long raised gravel berm along the north eastern edge of the street. The berm is to be a minimum of 100mm high and constructed such that access into the erven is not restricted. The berm is to be suitably compacted to prevent erosion and is to be maintained to facilitate conveyance of the stormwater runoff. The berm is to extend to the existing open earth channel and is to be surfaced where it crosses over the existing Road.
34	Construct an unlined stormwater cut-off channel in the position as shown on Figure 4. The channel will be approximately 900m long and should have a trapezoidal cross section with a minimum base width of 1m, depth of 1m and maximum side slope of 1V:2H. The cut-off channel is to discharge into the existing stormwater channel.
35	Construct surfaced speed bump/berm (<i>min 150mm high</i>) across Nentsa Street. Earthworks are required at the open area (point 36 on Figure 4) to direct stormwater runoff towards the berm and into the existing stormwater channel at point 37.
37	The existing stormwater channels are to be cleaned out and require regular maintenance to ensure that the channels are functioning at their designed capacity. Removal of litter would also improve the quality of the stormwater discharged downstream.
40	The existing stormwater channels are to be cleaned out and require regular maintenance to ensure that the channels are functioning at their designed capacity. Removal of litter would also improve the quality of the stormwater discharged downstream.

8.2 Long-term mitigation measures:

It is recommended that these mitigation measures be carried out to mitigate stormwater impacts arising from both conveyance and water quality issues. There are two main objectives associated with these interventions namely:

- Reduce the peak stormwater runoff leaving the developed site to pre-development levels; and
- Improve the quality of the stormwater runoff discharged downstream into the existing irrigation channel.

The long-term mitigation measures and their locations are summarised below in **Table 5**:

Table 5: Long Term Mitigation Measures

Item	Description of Intervention
10	Construct settling ponds and filtration beds (<i>vol. 2000 m³</i>) at location 10. This recommendation has been brought through from the Robertson SWMP (J&G, 2007) and is still required.
36	Construct a formal stormwater detention pond (<i>vol. 2500 m³</i>) at location 36. This detention pond will reduce the peak flow entering the downstream infrastructure and will mitigate flooding downstream.
38	Construct a formal stormwater detention pond (<i>vol. 4000 m³</i>) at location 38. This detention pond will ensure that the peak flows discharged from downstream are reduced to pre-development levels.
39	Construct a formal stormwater treatment facility at the detention pond (point 38). This should be a combination silt trap / bioswale that is designed to improve the quality of the stormwater discharged into the existing irrigation channel.

APPENDIX A - FIGURES

APPENDIX B – RAINFALL AND RUNOFF PARAMETERS

APPENDIX C – REVISED TABLE F.1: MITIGATION MEASURES