Stormwater Management Plan
Cornubia Retail Park

July 2013

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APPENDICES

Appendix A: General Layout

Appendix B: Stormwater Layout Plan

Appendix C: Rational Method Calculations
1. INTRODUCTION

SMEC South Africa (Pty) Ltd was requested by Tongaat Hulett Developments to compile a Stormwater Management Plan for the Cornubia Retail Park as part of the Environmental Impact Assessment (EIA) Application. The Cornubia Retail Park forms part of the overall Cornubia Precinct Development.

This stormwater management plan has the following objectives:

a) To protect all life and property from damage by stormwater and floods
b) To prevent erosion of soil by wind and water
c) To conserve the flora and fauna of the natural environment
d) To protect and enhance water resources in the catchments from pollution and siltation
e) To protect and enhance the local and downstream water courses

2. LOCATION AND DESCRIPTION OF SITE

Refer to FIG.1 (DH913-RP-EIA-01)

The Cornubia Retail Park Development is approximately 48 ha in extent consisting of five platformed sites. It is located north east of the M41 Highway close to the existing Flanders Drive Bridge (M41 crossing). The site is bounded in the south-west by the M41 Highway and Flanders Drive, in the north-west by the South African Sugar Association (SASA) Research Centre, in the north-east by the proposed future Cornubia Boulevard and to the south-east by a minor valley line.

The development will be separated and served by two new roads, SASA Boulevard and Dube East. The Retail Park Development will include two National Big Box Retailers as well as a Retail Style Development Centre as well as associated road and servicing infrastructure.

There is currently a Durban Solid Waste (DSW) Transfer Station situated within Site 3 with an area of approximately 1 ha. Site 2 is presently under sugarcane cultivation and a portion of Site 1 is densely vegetated by trees and bush.
3. IMPACT OF DEVELOPMENT ON EXISTING CATCHMENTS

The impacts of the proposed development on the environment will range from negative to positive depending on the degree of planning, design and methods of implementation. Measures put in place should contribute to the mitigation of the negative impacts of development.

Expected consequences of unmitigated development include an increase in hardened areas, reduced infiltration areas, loss of vegetation and evapo-transpiration potential. There will be an overall increase in surface runoff, an increase in the speed of runoff and peak flow rates.

4. MITIGATION OF DEVELOPMENT CONSEQUENCES

The recommendations in the specialist studies highlight the importance of adequate attention to the following key issues:

a) Improved wetland functionality and zero net-loss approach on wetland areas
b) Protection of the natural watercourses to prevent pollution, erosion and retain runoff
c) Promotion of subsoil infiltration where possible
d) Provision of indigenous vegetation along watercourses and stabilization of banks
e) Provision of in-stream installations at selected sites to trap first-flush pollution and non-soluble trash and litter entering the stormwater system
f) Attention to development of on-site use rainfall attenuation and provisions for reducing runoff by in-catchment and on-site evaporation and evapo-transpiration
g) Local flood risk reduction by selection of appropriate design standards for culverts and stormwater attenuation facilities
h) Implementation of adequate on-site and localized stormwater management practices
i) Attenuation of flood peaks to predevelopment levels at the 2% (50-year) and the 10% (10-year) risk level
j) Provide new permeable areas with sufficient flood attenuation and evaporation provision
k) Rehabilitation and upgrading of open spaces following conversion from sugarcane

These issues must be carried through the Stormwater Management Plan to the Parks & Landscaping plan.

The Stormwater Management Plan described below lists many practical on-site controls to address these fundamentals issues. However, this does not exclude any technology that can
be shown to be effective in controlling runoff while supporting the proposed spatial development intensity levels and contributing positively to the environment.

To fully mitigate the negative impacts of development:

a) The potential increase in flood peaks must be mitigated to at least pre-development levels by the provision of sufficient stormwater attenuation facilities at micro and macro levels.

b) The potential increase in flood volumes must be mitigated where possible by subsoil infiltration, retention of runoff in on-site facilities for irrigation use and unsaturated wetland areas where evaporation and infiltration can help to reduce flood runoff rates.

c) Installations must be provided to contain pollution as close to source as possible and in a practical location for servicing by Department of Solid Waste.

5. MAJOR RISKS

5.1 Erosion
On steeper slopes, erosion can take place extremely quickly once initiated, resulting in dongas and undermining structures. The damage to the watercourse will seriously impact not only on the site of the erosion but could damage neighboring properties and any dams and wetlands located in the downstream valleys where the eroded sediment will be deposited. The cost of correcting the damages will be substantially more than the precautions required avoiding the damages.

5.2 Flooding
The proposed development will tend to reduce the natural rainfall infiltration and increase storm runoff. Downstream flood damage risks will therefore increase unless adequate attenuation of flood runoff is provided. The design of the stormwater system must address this issue as far as possible and must be designed such that the downstream post-development flood risks are no greater than the pre-development flood risks.

As a guide to the degree of runoff attenuation required, pre-development and post development 50-year flood estimates are given in the attached appendices.

5.3 Pollution
Pollution of runoff must be avoided. In particular, provision must be made to contain first-flush runoff, either collectively in off-channel storage or on the individual sites where potential exists for stormwater pollution that is beyond limits acceptable to the estuarine environment.

Trash and litter traps must be provided before any watercourse from the retail park area reaches the proposed attenuation pond.
6. STORMWATER MANAGEMENT PHILOSOPHY

The major stormwater system consists of all natural water ways, including springs, streams, rivers, wetlands and dams. It includes attenuation dams and other devices constructed to control stormwater. Roadways and their associated drainage structures are also part of the major stormwater system if they result in a significant deflection of stormwater from its natural overland flow path.

The minor stormwater system consists of any measures provided to accommodate stormwater runoff within the development and road reserves and convey the runoff to the major stormwater system. These measures include gutters, conduits, berms, channels, road verges, small watercourses and infiltration constructions.

Stormwater runoff should not be concentrated to an extent that would result in any damage to the environment during storms with a probability frequency more than 1 in 10 years and would result in only minor, repairable damage in storms with a probability frequency of more than 1 in 50 years. All elements of the built and natural environment must be able to withstand a 1 in 50 year storm event without significant consequential loss and risk to property and life.

Note that a “storm frequency” equates to a “probability of occurrence” of a storm event that should be used to assess the annual budget or insurance provision for remedial works, should the event occur.

Water courses and built stormwater infrastructure must be maintained in a clean state, free of any rubbish, debris and matter likely to pose any pollution threat to the lower reaches of the water courses.

The Storm water Management Philosophy for the Cornubia Retail Park encourages the developer, the professional teams and contractors to do the following:

a) Maintain adequate ground cover in all areas and at all times to negate the erosive forces of wind, water and all forms of traffic.

b) Prevent concentration of stormwater flow at any point where the ground is susceptible to erosion.

c) Reduce stormwater flows as much as possible by the effective use of attenuating devices.

d) Ensure that development does not increase the rate of stormwater flow above that which the natural ground can safely accommodate at any point.

e) Ensure that all stormwater control works are constructed in a safe and aesthetic manner in keeping with the overall development.

f) Prevent pollution of water ways and water features by suspended solids and dissolved solids in stormwater discharges.
g) Contain soil erosion, whether induced by wind or water forces, by constructing protective works to trap sediment at appropriate locations. This applies particularly during construction.

h) Avoid situations where natural or artificial slopes may become saturated and unstable, both during and after the construction process.

7. STORMWATER MANAGEMENT POLICY

The following rules are to be observed by the developer, the professional team, contractors and sub-contractors:

a) Designs for the buildings and site development in general must avoid concentration of stormwater runoff both spatially and in time and may be required to provide for on-site attenuation of stormwater runoff to limit peak flows to pre-development levels.

b) Detailed plans to control and prevent erosion by water must be agreed prior to the commencement of any works, including site clearance, on any portion of the site.

c) Removal of vegetation cover must be carried out with care and attention to the effect, whether temporary or long term, that this removal will have an erosion potential.

d) Precautions shall be taken at all times on building sites to contain soil erosion and prevent any eroded material from being removed from the site.

e) Landscaping and re-vegetation of areas not occupied by buildings or paving shall be programmed to proceed immediately after building works have been completed, or have reached a stage where newly established ground cover is not at risk from the construction works.

f) On-site stormwater control systems, such as swales, berms, soil fences and attenuation ponds are to be constructed before any construction commences on the site. As construction progresses, the stormwater control measures are to be monitored and adjusted to ensure complete erosion and pollution control at all times.

g) Earthworks on sites are to be kept to a minimum. Where embankments have to be formed, stabilization and erosion control measures shall be implemented immediately.

h) Stormwater must not be allowed to pond in close proximity to existing building foundations.

i) Prior to any physical work proceeding on site, a stormwater control plan (SCP) detailing the proposed stormwater control measures are to be formulated. No work is to be undertaken without an approved SCP.

j) The Stormwater Control Plan must describe what control measures are to be implemented before and during the construction period, as well as the final stormwater control measures required for the site on completion of site
development. Plans must indicate who is responsible for the design of the control measures and who is, or will be, designated as the responsible person on site during each stage of the implementation of the control measures.

k) Stormwater Control Plans must show that all the provisions, regulations and guidelines contained in this document have been taken into account.

l) In the event of a failure to adequately implement the approved stormwater control plan, the contractor shall be responsible for making good all consequential environmental damage at his own cost. The developer is therefore advised to ensure that all members of the professional team and contractors are competent to undertake the development work and are adequately insured.

8. CRITICAL ASPECTS

Stormwater drainage is a crucial aspect in the development of the Cornubia Retail Park and will require careful planning, designing and managing.

The proposed stormwater attenuation pond should be designed for the 50-year storm event and located at an appropriately selected site. Site selection must take account of the necessary geotechnical, environmental and topographical conditions, including wetland conservation.

In addition to macro stormwater measures, micro-stormwater measures should be implemented. The form of this attenuation will be dependent on a number of factors such as topography (natural and artificial slopes), the zoning of the site and soil conditions present. A limited stormwater pipe network should be provided for stormwater reticulation to safely convey minor stormwater runoff to the attenuation facility.

To ensure that water quality is not compromised, silt and trash traps will need to be provided within the system. Where conditions permit, open ditches, drains and channels should be used instead of pipes. Attention must be given to the erodibility of channels where flow velocities are high and appropriate lining provided. Forms of lining will vary from natural vegetation to stone pitching and reinforced concrete linings.

The proposed development should not adversely impact on the environments of the development node and surrounding areas in terms of erosion and sediment deposition, but the frequency of flooding and the total runoff volume will increase unless adequate provision can be made to maintain the current natural rate of stormwater attenuation and infiltration in the sub-catchments.

A stormwater systems model should be developed during the detailed design phase to determine peak flood flow rates and flood levels and assess the collective impacts of development on runoff patterns. The outputs from the modeling will provide the input data
required for the design of culverts, channels and other stormwater infrastructure associated with the proposed developments.

For areas flowing into the development area, potential future development in these sub-catchments should be considered and any requirements for stormwater attenuation should be identified. Similarly, for stormwater flowing out of the development area may impact on the downstream watercourse and this must be considered and measures taken to ensure any upstream development does not result in an increased flood damage risk downstream.

Areas within the proposed development that bound on stormwater attenuation areas, near road crossings, watercourse confluences and water features could be subject to flooding. In these situations no development should take place below the outfall levels of water attenuation areas, plus an appropriate freeboard allowance.

Overland flow may be encouraged where possible, but should be avoided in the specific areas identified. These are typically where roads will capture and concentrate cross flows at the local low points in the roads. Plans must take into account probable impact of flow from these points of concentration on the downstream environment.

Steeper stormwater channels will require protection from erosion through the use of appropriate channel lining, or controlled drops to dissipate flow energy.

All natural and unlined channels should be inspected for adequate binding of soil by sustainable ground cover. Stone pitching should be used to reinforce channel inverts on steep slopes. Existing wetlands and stormwater attenuation areas should be protected from encroachment by the development.

9. GUIDELINES FOR OWNERS AND DEVELOPERS

The developments within the Cornubia Retail Park will be required to control stormwater runoff in accordance with the stormwater management philosophy and policies of Tongaat Hulett Developments and the eThekwini Municipality.

The following guidelines are intended to assist the design of the major and minor stormwater systems infrastructure and to ensure that the objectives of this Stormwater Management Plan are met during the planning, design, construction and operational phases of all developments.

Where prescriptive wording is adopted, the guideline shall be accepted and implemented as a rule.
9.1 STORMWATER RUNOFF CONTROL

Formal surface and underground stormwater systems will be provided in the overall development for the acceptance of stormwater drainage, but it is important that the peak runoff rate does not exceed the hydraulic capacities of the elements in the major stormwater system. The following are general guidelines for stormwater control from sites.

9.1.1 Buildings

Any building will inevitably result in some degree of flow concentration, or deflection of flow around the building.

The developer/owner shall ensure that the flow path of the stormwater is adequately protected against erosion and is sufficiently roughened to retard stormwater flow to the same degree, or more, as that found in the natural pre-development state of the site.

Where the construction of a building causes a change in the natural flora of the site that might result in soil erosion, the risk of soil erosion by stormwater must be eliminated by the provision of approved artificial soil stabilization devices, or alternative flora suited to the changed conditions on the site.

Where a piped stormwater system exists, any on-site stormwater drainage system should be connected to this external system. Any inlet to a piped system shall be fitted with a screen, or grating to prevent debris and refuse from entering the stormwater system. This must be done immediately on installation of the piped system.

No building works, earthworks, walls or fences may obstruct or encroach on a watercourse inside or outside the site without approved plans that do not compromise the objectives of the Stormwater Management Plan.

9.1.2 Roof Drainage

Building designs must ensure that rainfall runoff from roofing and other areas, not subjected to excessive pollution, must be efficiently captured for re-use where possible for on-site irrigation and non-potable water uses.

Where ground conditions permit, rainwater runoff that is not stored and utilized on site must be connected to infiltration galleries or trenches designed to maximize groundwater recharge. Infiltration facilities must be large enough to contain at least the first hour of a minor storm’s runoff without overflowing.

Infiltration trenches must be aligned along the contour on the downstream side of the property such that any spillage during major storms results in sheet overland flow.
Where a piped stormwater system has been provided to a property, surplus runoff should be connected to this system. Garden and other debris must be trapped on screens or gratings before entering the municipal or local development’s stormwater system.

9.1.3 Parking Areas and Yards

Any external parking area, yard or other paved area must be designed to attenuate stormwater runoff from a major storm to an acceptable degree.

Any area described above must discharge rainwater flowing over, or falling onto its surface, in a controlled manner either overland as sheet flow, or into an attenuation facility, or infiltration gallery suitably sized to accommodate minor storm runoff.

9.1.4 Roads

The principle of overland flow should apply to roadways where possible and roads should be designed and graded to avoid concentration of flow along and off the road.

Where flow concentration is unavoidable, measures to incorporate the road into the major stormwater system should be taken, with the provision of attenuation storage facilities at suitable points.

Inlet structures at culverts must be designed to ensure that the capacity of the culvert does not exceed the pre-development stormwater flow at that point and attenuation storage should be provided on the road and/or upstream of the stormwater culvert.

Outlet structures at a road culvert or a natural watercourse must be designed to dissipate flow energy and any unlined downstream channel must be adequately protected against soil erosion.

9.1.5 Stormwater Storage Facilities

The sufficiency and effectiveness of on-site alternative storage to meet stormwater attenuation requirements within the minor and major stormwater systems is the responsibility of the property owner. Any attenuation pond shall be integrated with the landscape on the site. Attenuation ponds shall be maintained in good condition and shall not be permitted to become a health hazard or nuisance.

The eThekwini Municipality shall have the right to inspect any stormwater drainage control facility at any time and issue instructions for repair and maintenance works deemed to be necessary, which instructions must be carried out within the prescribed time period.

9.1.6 Subsurface Disposal of Stormwater

Any construction providing for the subsurface disposal of stormwater should be designed to ensure that such disposal does not cause slope instability, or areas of concentrated
saturation or inundation. Infiltration structures should be integrated into the terrain so as to be unobtrusive and in keeping with the natural surroundings.

9.1.7 Channels

Lined and unlined channels may be constructed to convey stormwater to a natural watercourse where deemed necessary and unavoidable. Channels must be constructed with rough artificial surfaces, or lined with suitable, hardy vegetation, to be non-erodible and to provide maximum possible energy dissipation to the flow.

9.1.8 Energy Dissipaters

Measures should be taken to dissipate flow energy wherever concentrated stormwater flow is discharged down an embankment or erodible slope and the resulting supercritical flow poses a significant risk to the stability of the waterway.

Attenuation devices should be provided at the head of the energy dissipating structure if possible.
A means of dissipating energy must be provided at the outfall of any drop structure to ensure stormwater flow is returned to a safe sub-critical state, or to disperse the flow.

9.1.9 Flow Retarders

Stormwater flow should be retarded wherever possible through the use of surface roughening or other flow restricting devices, provided these are designed and built to avoid blockages that could result in environmental and structural damage.

All such constructions must be regularly maintained by the owner and may be inspected at any time by eThekwini Municipality or their appointed representatives.

9.2 STORMWATER POLLUTION CONTROL

No materials, fluids or substances are allowed to enter the stormwater system that could have a detrimental effect on the flora, fauna and aquatic life in the water courses, wetlands and dams. Regular monitoring of the sites should be undertaken by eThekwini Municipality or their appointed representatives.

Any site that is required to store any substances that could be regarded as hazardous in terms of water pollution shall notify eThekwini Municipalities and shall take measures to ensure spillages of the substance(s) can be adequately contained to prevent contamination of the water resources within the development area.

No stormwater, wash water, or waste water may be directed towards any permanent water body or wetland without the installation of a suitable filtration system to prevent pollution, including silt, from entering such water body.
9.3 **STORMWATER EROSION CONTROL**

The eThekwini Municipality should inspect the development on a regular basis to:

a) Determine the effectiveness of the stormwater management policies and amend policy as and when necessary to meet the objectives of the Stormwater Management Plan.

b) Advise the property owner / manager of any repair, maintenance and improvement works required on the stormwater system control elements within their jurisdiction.

9.4 **SAFETY**

9.4.1 **Structural Damage**

The diversion or concentration of stormwater, whether on the surface or underground, must not increase the risk of structural damage to any development within the Cornubia Retail Park.

The above includes the undermining of structures due to erosion of soil and/or the subsidence of structures due to saturation of the foundations by stormwater.

10. **STORMWATER PLAN IMPLEMENTATION PROCEDURES**

The following procedures are to be followed by owners, developers, appointed agents, professional teams and contractors:

a) **Application for Permission to Build**

A copy of the Stormwater Management Plan shall be obtained from Tongaat Hulett Developments or eThekwini Municipality.

b) **Site Survey and Investigations**

Anyone involved in site survey and investigation work shall be familiar with the contents of this Stormwater Management Plan.

c) **Design Stage**

The professional team shall take into account the Stormwater Management requirements contained in this document and shall clearly indicate on all plans and in any contract document where and how measures have been provided in the design to ensure the Stormwater Management requirements are implemented. Approval from the eThekwini Municipality must be obtained before commencing construction.
d) Construction
The contractor shall prepare a Stormwater Control Plan to ensure that all construction methods adopted on site and within the Cornubia Retail Park do not cause, or precipitate, soil erosion and shall take adequate steps to ensure that the requirements of the Stormwater Management Plan are met before, during and after construction. The designated responsible person on site, as indicated in the Stormwater Control Plan (usually the contractor) shall ensure that no construction work takes place before the Stormwater Control measures are in place.

e) Certificate of Occupation
On completion of the works, the eThekwini Municipality, or their appointed professional person will inspect the site for compliance with the Stormwater Management requirements, prior to the issuing of a Certificate of Occupation by the eThekwini Municipality.

f) Occupation Period
During occupation of any property, eThekwini Municipality may undertake periodic inspections, to ensure the Stormwater Management Policy is being correctly implemented, and may serve notice on occupants to undertake remedial work, which is deemed necessary in the opinion of eThekwini Municipality.

11. COMPLIANCE WITH STORMWATER MANAGEMENT POLICY

The developer and his professional team, including the contractor, shall be responsible for ensuring that the requirements of this Stormwater Management Plan are met.

The developer and his professional team shall be responsible for the performance of all stormwater control measures implemented on a site under their jurisdiction and the impact such works may have on downstream property within the Cornubia Retail Park.

Approval of any plan or document, whether verbally or in writing, by the eThekwini Municipality shall not be construed as absolving the owner or the professional team of this responsibility.
12. HYDROLOGY AND HYDRAULICS

12.1 Rational Method
(Refer to Appendix C)

The Department of Water Affairs (DWA) Rational Method was used to estimate the peak stormwater runoff as a result of this development. The results of these calculations indicate that approximately 4,100 m$^3$ (dry attenuation pond) and 300 m$^3$ (on-site storage) of attenuation volume is required to accommodate the increase in stormwater runoff in a 1:50 year storm.

Rainfall data obtained from eThekwini Municipality was used in these calculations.

13. PROPOSED STORMWATER SYSTEM

Stormwater runoff from sites 4a and 4b will discharge into the existing Flanders Drive / M41 stormwater system. The additional stormwater runoff volume generated as a result of the development of these sites will be attenuated on site.

The increased post-development runoff from the balance of the sites will be attenuated at a dry pond at the eastern side the development (as indicated on Drawing No. DH913-RP-SWMP).

Maximizing the flow path length is encouraged to maximize the attenuation in the micro stormwater system. Stormwater will be released from the development into existing drainage systems at pre-development (1 in 10 and 1 in 50 year) flow rates.
CONCLUSION

Appendix C summarizes the results of the preliminary Rational Method calculations for the development. It is evident from these results that one of the negative impacts of the development is a substantial increase in the peak stormwater runoff flows for both the 1 in 10 and 1 in 50 year return periods.

The increase in peak runoff will primarily be mitigated by the installation of on-site attenuation structures for sites 4a and 4b and by a proposed dry attenuation pond for the balance of the sites. However, the introduction of supplementary sustainable drainage technologies during the detailed design phase is encouraged.

The attenuation installations will reduce the post-development peak runoffs for the 1 in 10 and 1 in 50 year storms to pre-development levels. With this in mind, it is recommended that the hydraulic characteristics of the stormwater network is analyzed (using EPASWMM or similar software) during the detail design phase of the project. This analysis will accurately determine the attenuation volumes and outlet configuration required to reduce the peak outflows to pre-development levels.
APPENDIX A
APPENDIX B
CORNUBIA RETAIL PARK

TABLE 1

RATIONAL METHOD CALCULATION (1:50 YEAR RP)

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<th>Site 1</th>
<th>Area (ha)</th>
<th>Rainfall Intensity (mm/hr)</th>
<th>Peak Flow (Q) (m³/s)</th>
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<th>Volume (m³)</th>
<th>C_{pre}</th>
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<th>Area (ha)</th>
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Appendix C