NJV 11 MKHUZE LODGE

ZULULAND RHINO RESERVE

ENGINEERING REPORT

REV 0

8TH DECEMBER 2017

- NJV11-MKHUZE LODGE-ENGINEERING REPORT-V1-20171206

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1. INTRODUCTION

This document is introductory discussion on the engineering design concepts for the new lodge development and how they might interface with the site and other development requirements. This report was prepared at time of submission of the environmental report to Local Authorities.

1.1 Purpose of the Report

The purpose of this report is to define in narrative form the CIVIL AND STRUCTURAL criteria for the development, the likely suite of materials, and the likely standards and procedures to be used in the design.

1.2 Scope

The scope of this report covers the conceptual design discussions for the lodge building cluster comprising the main lodge, pool sala and eleven accommodation units.

2. GENERAL PROJECT INFORMATION

The site is located on the mid to lower central slopes of an approximately north south trending ridge, to the east of a southerly flowing small tributary of the Msunduzi River, which flows into the Msunduzi River at a distance of approximately 3.8 km to the south east of the site.

2.1 Topography

The site for the lodge cluster is fairly flat, and the buildings are to be positioned back from the top of the river bank in accordance with the requirements of the Geotechnical Engineers recommendations and the environmental requirements.

2.2 Geology and soil conditions

A Geotechnical Engineering investigation has been carried out by Drennan Maud (Pty) Ltd, dated 8th November 2017.

There is generally overlying alluvial and residual material occurring on the site and excavation is expected to be easy. These materials may be unstable and side wall collapse should be expected when excavating foundations.

Founding of the structures on strip footings and column base will be achievable. The rigid primary structures would be founded on bases excavated to the level of the weathered bedrock (no more than 3m below the current ground level) , and the secondary wall structures or timber structure framework may be designed onto strip footing arrangements

excavated into moisture stable soils approximately 1,5m below the finished ground level. Both strip footings and column base footings will require to be designed for a limited ground pressure of 100KPa in accordance with the Geotechnical recommendations.

2.3 Ground Water

No groundwater is likely to occur where the lodge cluster site is proposed. However, during periods of high rainfall and towards the lower southern portion of the site, adjacent to the stream and dam groundwater seepage may occur at the contact between the colluvial soils and the residual soils and underlying weathered bedrock.

2.4 Particular Building Guidelines of the Rhino Reserve

There is a set of regulations incorporating Building and Contractor regulations for development within the Reserve. It is noted that these are not expected to impact on the structural design for the buildings within the Architectural scheme as presented to date. Suffice to say that care and attention needs to be made in the conceptual design phase to economise, and act with sensitivity to the site location when decisions are made as to materials and methods of construction.

3. THE CONCEPTUAL ENGINEERING SCHEME

3.1 Particular Building Guidelines of the Rhino Reserve

The concept of the naked building structures can be described as a series of structural steel beam grillages, supported off either timber or steel columns, and braced utilising the timber stud/clad wall systems as structural shear walls, or where defined by the Architecture, by masonry walls.

Columns and shear walls will be connected onto concrete plinths and stub columns off the foundations.

As such the structures can be loosely described as composite steel and timber modularised frames.

Roofs will generally be sheeted with lightweight steel profiled roof sheeting.

Fenestration and sliding/folding glazed screens will be co-ordinated to be supported within the structural modularisation methodology.

A particular feature will be the reinforced rammed earth feature wall.

The following features outline the intended design development outcomes:

- Steel and timber above ground, Concrete at and below ground other than as particularly required by the Architecture.
- " Touch the earth lightly"

- Modularise a steel beam grillage framework to incorporate lines of fenestration in any direction and to support the sheeting rails.
- "Tipped" roof planes to support sheeting
- Connection typologies will be developed with the Architect to create an aesthetic to the structural connections that allows adequate load transfer at all of the interfaces.

3.2 Pool Structure

It is envisaged that a structural box format will be used for the approach to the pool structure. This can be achieved either with a shuttered and cast wall system, or alternatively and reinforced infill masonry structural wall system. It is envisaged that the pool based will be supported onto a series of RC columns in turn supported at bedrock level on spot bases.

3.3 Floors, Foundations and Reinforced Concrete

All columns will be supported off concrete pad footings designed in accordance with the ground pressure limitations recommended in the Geotechnical report, and the general typology foundation systems described above..

Generally it is not anticipated that there will be significant concrete structure above ground level.

Where necessary, walls will be supported off reinforced concrete footings cast onto adequately compacted layer works.

Floors have been discussed as either of the following:

- Raised timber decks. These have the advantage of allowing underfloor reticulation of services. Spans and in particular, cantilvere spans, may require structural steelwork frames at floor level.
- On grade concrete surface beds.

3.4 Earthworks

Due to the sensitive nature of the area to be developed, very limited earthworks, consisting mainly of localised levelling is envisaged. The geotechnical report indicates that excavation to a depth of 3m is expected to be easy and as such the limited earthworks could potentially be undertaken using manual labour rather than mechanical equipment.

Any new roads will be designed as a cambered gravel road as per Draft TRH 20. The Structural Design, Construction and Maintenance of Unpaved Roads. Side drains will be used where natural dispersion of surface water is disrupted, as the concentration of stormwater is the root cause of erosion. The side drains should run parallel to the

road, collecting the surface water from the pavement and shoulders and removing it through mitre drains (or turnouts) as far from the road as practically possible, where it can soak into the ground or flow into a natural drainage course without influencing the road structure. The distance between mitre drains (which need not necessarily always be associated with sidedrains) depends on their grade with a smaller spacing on flat grades and greater spacing (not far enough to cause excessive flow velocities) between them on steeper grades. The principle is to place the mitre drains at intervals which avoid ponding adjacent to the road but not far apart enough to allow the build-up of high concentrations and flow velocities which lead to scouring.

The width of mitre banks should generally be 1 to 1,5 metres. The importance of the road surface being raised above the surrounding area is obvious. When the surrounding area is higher than the road surface, the road becomes the drain during periods of heavy rainfall and rapidly becomes deformed or even impassable if the water soaks in.

3.5 Bulk Water

The source of potable water will be from an existing borehole off site which will be pumped to an elevated tank and gravity fed to the lodge complex. Unknown what the existing yield from the borehole is at this stage.

The water reticulation will be designed as per the indicated in the *"Guidelines for the Provision of Engineering Services and Amenities in Residential Township Development".* The design criteria used is SANS 10252-1. An allowance of 250ℓ/bed/day has been used in the water demand calculations.

The internal water pipes will be sized to cater for the proposed developments peak water demand and fire requirements. The internal water reticulation system will be a pressure main with the twin booster connection and water meter remaining in its current position.

The following are assumed:

1. Demand rates are according to SANS 10252-1
2. Reticulation losses assumed at 20%

Hotels			
Average density	26 Beds x 250ℓ/p/d		6.5 kℓ/d
Add losses (20%)			1.3 kℓ/d
		=	7.8 kℓ/d
		=	0.090 ℓ/s
Instantaneous peak flow factor (PF)		=	2.5
Instantaneous peak flow		=	0.090 ℓ/s x 2.5
		=	**0.225 ℓ/s**

3.6 Stormwater

The design intent is to create landscaping commensurate with the existing bushland and there is no intention to create berms or other such natural features which would change the natural stormwater runoff in open areas.

Open timber decks are intended to be open jointed such that the rainwater runoff simply drains onto the ground below and drains away naturally or percolates into the ground.

Stormwater management is therefore limited to:

- The water draining off the roof structures. There are no gutters on the roofs, which are monopitched towards back of house and allow a sufficient overhang from the building walls to allow for runoff from the roof to fall directly onto the ground.
- At the ground line zone strip that will be situated under the roof edge, the Architectural treatment will be such that the landacsaping can accept this runoff without degradation or erosion and the rainwater will be allowed to fall away from the building without concentration into the natural soils surrounding the lodge complex

  Any areas that require concentrated collection of storwater as a result of design development, or for example, pool backwashing procedures, will be drained with a below ground piped system which will terminate at the adjacent existing dam where it will be discharged through a headwall system complete with flow reducing splitter blocks and reno mattresses, given the very small additional stormwater attenuation volumes required, no work to the existing dam is envisaged.

  (*Refer to Stormwater Management Plan dated December 2017, complied by NJV Consulting).*

3.7 Sewer

The most practical means of waste water disposal is a sub-surface system in the form of a septic tank and soakaway. It is envisaged that each unit will discharge waste water via a gravity system to a septic tank from where the effluent will drain to a suitably designed and sized French drain soakaway system and evapotranspiration area. (Refer to Annexure A – Proposed Sewer Layout)

In terms of the layout provided and the likely maximum occupancy of the development, the effluent loading based on the Code of Practice for the application of National Building Regulations SABS 0400 of 1990 and the Building Standard Act No. 103 of 1997, is estimated to be the following;

Unit Type 1 results in an effluent loading (E) of 280 ℓ/day x 11 Units = 3 080 ℓ/day
Main Lodge results in an effluent loading (E) of 840 ℓ/day

Total Effluent = 3 080 ℓ/day + 840 ℓ/day = 3920 ℓ/day

Septic Tank

One requires at least 48hours flow through a septic tank.

Unit Type 1 = 280 ℓ/day x 2 = 0.560m³

From NHBRC Home builder's guidelines the minimum size for a septic tank is 1,7m³, therefore a 1,7m³ tank will be utilised.

Main Lodge = 840 ℓ/day x 2 = 1.68m³

From NHBRC Home builder's guidelines the minimum size for a septic tank is 1,7m³, therefore a 1,7m³ tank will be utilised.

Septic tank size is 3m x 1m x 0,57m deep (Internal dimension)l.

Founding for the septic tank must be approved by an Engineer.

Soakaway

All the sewerage from the site will flow in solid form via a sewer network into a septic tank were the solids and liquids are separated. The liquids will be pumped via a sewer rising main to a soakaway French drain system and evapotranspiration area.

The design of the soakaway was carried out using "NHBRC Home builder's guidelines".

Soakaway dimensions

Width = 0.6m

Depth = 0.7m

L = (Surface area – area of trench ends) / (height of trench)

L = ([2 176/100l/m²] – [0.6 x 0.7 x 2]) / (0.7 x 2) = **21.16m**

In order to maximise the evapotranspiration area a 34m long soakaway is proposed.

Soakaway = 34m long x 0.6 wide x 0.7 deep.

Sewer Evapotranspiration Area

A percolation test was carried out as part of the Geohydrological Assessment (*Refer Geohydrological Assessment For Proposed Mkhuze Lodge, Northern Kwazulu-Natal, IDM Consultamnts dated November 2017)* which confirmed that a french drain soakaway system was suitable for the site, given the insitu ground condition, the total evapotranspiration area required is as per the calculation below;

Ar = [Fc x Fd x Et]/e (m²)

Ar	=	Minimum required evapotranspiration area (m²)
e	=	Evapotranspiration rate
Fc	=	Terrain concentration factor
Fd	=	Deep infiltration factor
Et	=	Effluent loading.

Ar = [1.0 x 1.0 x 3 920] / 1.82 = **2 154m²**

4. DESIGN STANDARDS AND SOURCES OF REFERENCE

4.1 Statutory Regulations and Bye-Laws

Reference is made to the Zululand Rhino Reserve building guideline document.

4.2 Statutory Regulations and Bye-Laws

SANS 10160: 2008
Basis of structural design and actions for buildings and industrial structures.
Parts 1 to 8

SANS 10100-1 Ed.2.2
The structural use of concrete Part 1: Design

SANS 10100-2
The structural use of concrete Part 2: Materials and execution of work

SANS 10144-1995
Detailing of steel reinforcement for concrete

SANS 10162-1: 1993
The limit states design of hot rolled steelwork

SABS 0164 Part 1-1980
The structural use of masonry Part 1: Unreinforced masonry walling

SANS 2001-CS1:2005
Construction works Part CS1: Structural steelwork

SANS 0163-1:1994
The Structural use of Timber

4.3 Other Sources of Reference

Geotechnical Report

Compiled by Drennan Maud (Pty)Ltd, Durban head office, reference 31843-2, dated 8th November 2017.

Environmental report
Preliminary assessment carried out by ENAQ Consulting cc dated October 2017.

5. IMPOSED CONDITIONS

5.1 Design Loadings

The following loads should be used in the preliminary design calculations. As the various load categories develop and are finalized these loads will be revised during design development to reflect the reality of the structure.

5.1.1 Structure Self Weight

The self-weight of all structural elements will be calculated in accordance with the relevant material densities and to the particular geometry denoted on the structural drawings, and will exclude any applied finishes, claddings and partitions.

5.1.2 Imposed Dead and Live Loadings

Live load reductions will be calculated in accordance with the requirements of SANS 10160.

- Reinforced concrete roofs to be schemed for the following imposed loads
  - 250kg/m2 for screed and finishes (50mm stone + 75mm screed)
  - 35kg/m2 for services and ceilings
  - 50kg/m2 for imposed live loading (inaccessible roof)

- Sheeted structural steelwork roofs to be schemed for the following imposed loads

  - 20kg/m2 for ceilings
  - 15kg/m2 for suspended services in the roof space
  - 25kg/m2 for imposed live loading (inaccessible roof)

5.1.2 Imposed Wind Loading

- Wind loading pressures to be calculated using the provisions of *SANS 10160 Part3: Wind Actions*

5.2 Other Performance Requirements

5.2.1 Building Design Life

The indicative design working life of the building would be considered appropriate as 50 years. This is not necessarily an indication of the service life, but will be used as the design norm for design code applications.

5.2.2 Durability

The levels of exposure of the reinforced concrete structures are deemed to be:

- Externally exposed faces, such as vertical faces of slab edges, open Slab soffits, external beams and the like, the level of exposure is MODERATE
- Internal faces, generally considered to be 'indoors' and not exposed to external weather conditions, the level of exposure is MILD-MODERATE.

5.2.3 Fire Resistance Periods

All structural reinforced concrete elements will be sized to achieve a 2 hour fire rating

5.3 Construction Implications

5.3.1 Construction Tolerances

It will be assumed that the building structures will generally be constructed to degree of accuracy II (SANS 1200)

6. MATERIALS

6.1 Structural Material

6.1.1 Concrete

Blinding	-	10 MPa / 19mm
Ground beams and footings	-	25 MPa / 19mm
Retaining walls	-	25 MPa / 19mm

Surface beds	-	25 MPa / 19mm
Columns	-	30 MPa / 19mm
Suspended Slabs & Beams	-	30 Mpa / 19mm

6.1.2 Steel

All structural steelwork will be executed in accordance with the following standardised specifications, with variations and additions as listed in Portion II of this specification.
SANS 2001 – CS1:2005 Structural Steelwork
SANS 1067 -1984: Welding in steel structures

Design grades:

- Hot rolled sections SANS 50025-2-S355 JR
- Hot rolled Structural Tubing – EN 10219 Grade S355
- Hot rolled plate SANS 50025-2-S355 JR
- Cold rolled sections Yield stress 200MPa
  Tensile strength 365MPa

6.1.3 Timber (Structural Grade)

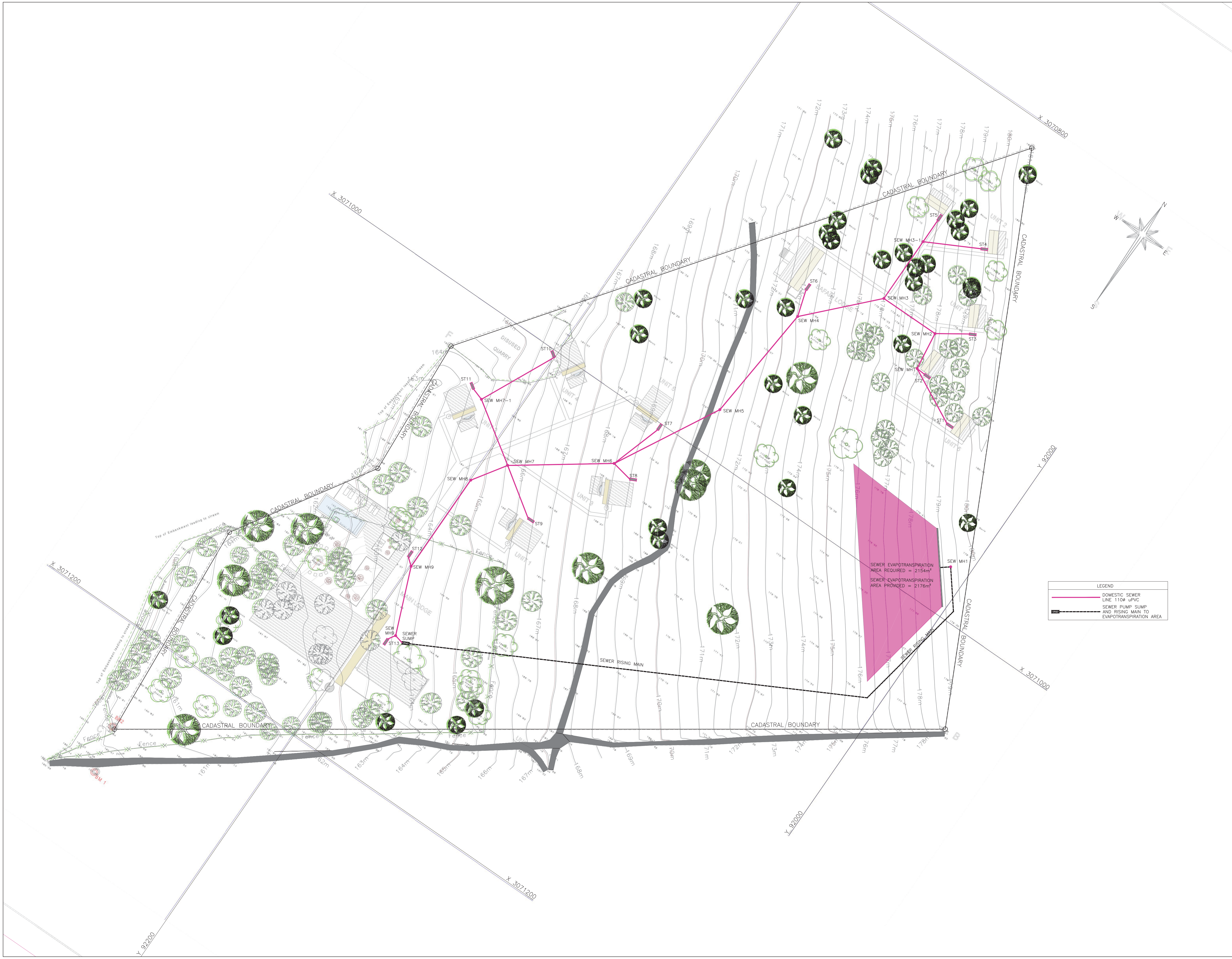
Timber will be sourced as the design develops, whereas the intention is to engage with champions of the timber industry to source and ascertain availability of timber types and suitability for the conditions.

END OF REPORT

LINDA NESS

Pr(|Eng) 940379

Annexure A
Proposed Sewer Layout



REV	DATE	DRAWN	DESCRIPTION	APP'D	DATE
0	28.11.2017	VP	ISSUED FOR INFORMATION		

GENERAL

A. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT SABS 1200 SPECIFICATIONS.

B. THE CONTRACTOR MUST ARRANGE FOR CONTROL TESTING AT FREQUENCIES SPECIFIED IN THE RELEVANT SABS 1200 SPECIFICATIONS. COSTS FOR CONTROL TESTING WILL BE FOR THE CONTRACTORS ACCOUNT.

C. ONCE THE WORKS ARE SET OUT THE CONTRACTOR MUST CALL THE ENGINEER FOR INSPECTION PRIOR TO COMMENCING WITH THE EXCAVATION.

D. SHOULD THE CONTRACTOR DISCOVER ANY DISCREPANCIES IN THE DRAWINGS, THESE DISCREPANCIES MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER IMMEDIATELY. NO ASSUMPTIONS MUST BE MADE.

E. SHOULD THE CONTRACTOR WISH TO USE ANY MATERIALS OTHER THAN THOSE SPECIFIED, HE MUST OBTAIN WRITTEN APPROVAL FROM THE ENGINEER TO DO SO.

F. ANY DESIGN CHANGES DURING CONSTRUCTION MUST BE ISSUED UNDER SITE INSTRUCTION, AFTER APPROVAL BY THE ENGINEER.

G. ALL EXISTING SERVICES TO BE PROVED & VERIFIED PRIOR TO WORK COMMENCING. ANY EXISTING SERVICE THAT IS DAMAGED BY THE CONTRACTOR AND IS SHOWN ON THE CONSTRUCTION DRAWINGS OR INDICATED TO THE CONTRACTOR ON SITE BY THE ENGINEER, MUST BE REPAIRED BY THE CONTRACTOR AT HIS OWN COST.

H. THE CONTOURS AND NATURAL GROUND LEVELS INDICATED ON THIS DRAWING ARE AS PER THE SURVEY DATA SUPPLIED. THE CONTRACTOR IS TO CHECK THE ACCURACY OF THIS INFORMATION AND REPORT ANY DISCREPANCIES IMMEDIATELY.

I. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE THAT ALL STORMWATER RUNOFF IS CONTROLLED TO PREVENT DAMAGE TO THE WORKS, EXISTING STRUCTURES AND SURROUNDING PROPERTIES, DURING THE CONSTRUCTION PROCESS.

J. ALL CUT AND FILL BATTERS TO BE 1:1,5 AND 1:1,75 RESPECTIVELY.

K. THE CONTRACTOR IS TO TAKE COGNISANCE OF THE GEOTECHNICAL REPORT AND THE RECOMMENDATIONS MADE THEREIN, SPECIFICALLY WITH REGARDS TO THE INSITU MOISTURE CONTENT OF THE MATERIAL.

L. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT DETAIL DRAWINGS.

EARTHWORKS

A. 100mm TOPSOIL TO BE STRIPPED AND STOCKPILED, TOPSOIL IS TO BE SPOILED ONLY WHERE DIRECTED BY THE ENGINEER.

B. IN SITU MATERIAL TO BE COMPACTED TO 93 % MOD AASHTO DENSITY.

C. ANY VERTICAL EXCAVATIONS (DEEPER THAN 1,2m) ARE TO BE BATTERED AT 1:2 OR SHORED.

D. ON NATURAL SLOPES EXCEEDING 1:6 FILL MUST BE BENCHED INTO COMPETENT INSITU SOILS AS PER THE TYPICAL DETAIL.

E. UNSUITABLE MATERIAL TO BE SPOILT AS INDICATED BY THE ENGINEER.

F. FILL TO BE COMPACTED IN MAX. 200mm THICKNESS TO 95 % MOD. AASHTO DENSITY.

G. ALL BATTERS TO BE TOPSOILED WITH MATERIAL FROM STOCKPILE.

STORMWATER

A. ALL STORMWATER PIPES ARE TO BE BEDDED AS PER THE TYPICAL DETAILS.

B. TRENCH DETAILS AS PER THE TYPICAL DETAILS.

C. ALL STW LINES STEEPER THAN 1:6 ARE TO HAVE ANCHOR BLOCKS EVERY SECOND COLLAR AND THOSE STEEPER THAN 1:3 EVERY COLLAR.

SEWERS

A. ALL SEWER PIPES TO BE 160mmø HEAVY DUTY uPVC, AND BEDDED AS PER THE TYPICAL DETAILS.

B. TRENCH DETAILS AS PER THE TYPICAL DETAILS.

C. TESTING OF SEWER PIPES TO BE CARRIED OUT IN ACCORDANCE WITH SANS 1200 LD.

D. ALL SEWER CHAMBERS TO BE 1m PRECAST RINGS.

E. WHERE SEWER PIPES PASS ABOVE STORMWATER PIPES THE MINIMUM DISTANCE BETWEEN THE PIPES MUST BE 0,15m. WHERE STORMWATER PIPES PASS ABOVE SEWER PIPES THE MINIMUM DISTANCE BETWEEN THE PIPES MUST BE 0,30m.

F. ANY DROPPED MANHOLES MUST BE INTERNAL DROPS AS PER THE TYPICAL DETAIL.

G. ALL EXISTING SEWER MANHOLES TO BE RAISED TO FINISHED DESIGN LEVELS

DESIGNED	DRAWN	CHECKED	APPROVED	SCALE
AJ	AS	VP	AJ	T.B.C

DWG No	REV	REFERENCE

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DRAWING TITLE
SEWER LAYOUT

PROJECT
PROPOSED MKHUZE LODGE

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PRELIMINARY ISSUE A0