

## APPENDIX 5: ENGINEERING REPORT



## **KLAARWATER STATION HOUSING – PHASE 1 ENGINEERING REPORT**

**DEVELOPMENT ENGINEERING DEPARTMENT  
ENGINEERING UNIT  
ETHEKWINI MUNICIPALITY**

**AUGUST 2018**

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### 3.3 GEOTECHNICAL ASPECTS

A detailed Materials and Geotechnical Investigation Report was prepared by Moore Spence Jones (PTY) LTD , and the following aspects were noted :

The site is underlain by a mantle of colluvial and residual soils which overlie sandstone bedrock of the Natal Group.

Transported soils of colluvial origin occur from ground surface, and comprise slightly moist to moist greyish brown to brown medium dense medium grained silty sands. This layer extends to an average depth of 0.8 metres ranging from the surface to about 1.4 metres below existing ground level.

Alluvial soils confined to the marshy or drainage line areas are expected to comprise dark brown clayey sands.

Residual soils, developed from the in situ weathering on the sandstone bedrock were encountered below the colluvium and comprised slightly moist brown, dark orange brown to yellowish brown and light grey medium dense to dense / firm to stiff gravely silty sands and sandy silty clays with gravel components comprising weathered sandstone boulders.

Residual soils extend to an average depth of 1.0 metres ranging from 0.6 to 1.5 metres below existing ground level.

The residual soils grade fairly abruptly into weathered sandstone bedrock of the Natal Group, which occurs at an average depth of 1.7 metres ranging between 0.4 and 2.6 metres below existing ground level. The bedrock comprises yellowish brown to orange brown and purplish brown streaked and mottled yellow speckled white moderately to completely weathered medium to coarse grained very soft to soft rock improving with depth sandstone.

The preliminary geotechnical report indicates that ground conditions are favourable for septic tank sanitation (however the waterborne system will be designed) . The residual soils are overlain with a thin cover of transported soils up to a thickness of 0,5m but increasing along the valley lines.

Where the natural ground slopes are steeper than 1 vertical to 6 horizontal (9 degrees), the fill should be benched into the in-situ material to promote founding stability. Benches should be a minimum 0.5 metre deep and 3 metres wide.

Slopes for cut embankments in stable and competent soil should be formed to batters of 1v : 1.75h (30°) and to a height not exceeding 1,5m; to be vegetated immediately. Fill embankments should be sloped throughout the project area not to exceed 26° and a height not greater than 1,5m where retaining walls are not provided. Embankments steeper / higher than these constraints should be stabilised with suitable measures to engineers detail.

Compaction density control tests should be undertaken at regular intervals during the development of fills as per the engineering specifications.

Valley bottoms and heads of valley comprise natural drainage paths. These areas of seepage will require control in the form of subsoil drains. Where roads traverse these areas, drainage control will be required.

Some seepage may occur on the upper steeper slopes where platforms are cut. Where earthworks take place in colluvial sands, care must be taken to prevent soil erosion, as these sands are highly susceptible to erosion.



## **1.0 INTRODUCTION AND BACKGROUND**

This report covers the design proposals for the construction of roads and storm-water drainage and water borne sewage, potable water, electricity and solid waste for the construction of Klaarwater Station Housing Project, eThekweni. It is submitted in support of the Project Linked Housing Subsidy application submitted by the Developer, eThekweni Human Settlements Unit.

The Development Engineering Department of the Engineering Unit, eThekweni Municipality, have been appointed by the eThekweni Human Settlements Unit to design and supervise the provision of civil engineering services for this in-situ upgrade project. It comprises of 325 new sites. There are approximately 300 existing informal structures which comprises the settlement.

## **2.0 LOCATION AND TOPOGRAPHY**

The proposed site is located in the western part of eThekweni Municipality, Wards 63 & 16, approximately 10km south west of Pinetown. It abuts the Nazareth Island Development project. Access to the development is from Marianhill and Northdene areas and along existing Wiltshire Road off Richmond Road and Hans Dettman Highway respectively, which borders the project area to the south east. The preliminary Town Planning Layout yields a total of 325 sites (325 units), of approximately 340 m<sup>2</sup> average size and encompasses an area of approximately 12,0 ha.

Topographically, the site is gentle to moderately sloping, with slopes facing to the east, southeast and northeast.

Vegetation on the site is as a whole highly variable. The steep sloping areas are generally covered by dense woodland vegetation comprising trees and shrub bush while gently sloping areas are generally covered by veld grasses and few scattered trees. The relatively low-lying valley bottoms are generally covered in hydrophilic vegetation and reeds indicating wet marshy conditions.

Soil mining or borrowing has been carried out in places across the site, adjacent to the river.

## **3.0 ENGINEERING DEVELOPMENT PROPOSAL**

### **3.1 GENERAL**

Best practice requirements require that services be designed to connect to the existing bulk municipal services infrastructure in order to accommodate the services requirements for the development of this nature. The internal services will be according to accepted engineering specifications and principles as well as acceptable environmental requirements and specifications, as provided in the environmental scoping and impact assessment reports. Availability of bulk infrastructure has been confirmed by relevant line departments, letters are attached as annexures.

### **3.2 EXISTING ENGINEERING SERVICES**

- Roads
- Water
- Sanitation
- Storm water

- Access ways

The following preliminary pavement design is proposed:

30mm Mix 'A' Asphalt.

130mm G2 Graded crushed stone base compacted to 98% Mod AASHTO density.

150mm Dump Rock.

150mm rip and re-compact in-situ material min CBR >3 @ 90% compacted to 95% Mod AASHTO density.

Undercut unsuitable material and replace with selected material.

#### 4.1.2 Geometric Design

The road design for the different road classes will be to the following standards:

##### CROSS SECTION DETAILS

ROAD CLASS	RESERVE WIDTH	PLATFORM WIDTH m	SURFACED WIDTH m	KERBING	SIDEWALK
Access way	6.0	6.0	3.0 asphalt/ concrete	Concrete / one side	1.0m / asphalt both sides
Residential street	8.0	8.0	3.0 asphalt	Concrete / both sides	1.0m / asphalt both sides
Taxi Collector Route	10.5	10.5	5.5 asphalt	Concrete or extruded asphalt / both sides	1.0m / asphalt both sides

##### GEOMETRIC STANDARDS

ROAD CLASS	MIN. RADIUS	BELLMOUTH RADIUS MIN.	MAX. GRADE %	LENGTH VERTICAL CURVE	MIN K CREST VALUE	MIN K SAG VALUE
Access way	10	8	20	10	1	1
Residential street	20	10	16.5	30	2	4
Taxi Collector route	105 abs. Min 45	10	16.5	40	10	8

- There cannot be any direct access to the Hans Dettman Highway due to safety and difference in road hierarchy, access will be from Wilshire Road.

#### 4.0 CIVIL ENGINEERING SERVICES - DESIGN PARAMETERS

The recommendations contained in the eThekweni Municipality's "Minimum Engineering Standards for Residential Development Schemes" will form the basis to formulate the design requirements and procedures applicable to the provision of services for the Klaarwater Station Housing Project. These recommended parameters will be applied and adhered to as far as the layout, topography, soil conditions, etc. permit.

Preliminary discussions have taken place with representatives from the following eThekweni Municipality Departments:

Development Engineering	-	Mr N. Dlamini
Coastal Stormwater and Catchment Management	-	Mr G. Tooley
eThekweni Waste Water	-	Mr B. Neale
eThekweni Water	-	Ms Z. Mzamane
eThekweni Electricity	-	Mr S. Govender

#### 4.1 Roads

The road design standards proposed are based on the eThekweni Municipality minimum engineering standards (Annexure A3 – High Density Developments). All roads will be surfaced with either asphalt or concrete.

The town planning layout utilises a combination of three road classes:

Access ways – up to 100 m in length (3,0 m wide on 6m road reserve).

Residential streets (4,5m wide on 8,0 m road reserve).

Taxi Collectors (5,5m wide on 10,5 m road reserve).

A roads layout drawing is included in the report as an annexure.

##### 4.1.1 Pavement Design

- Taxi Collector

The following preliminary pavement design is proposed:

50mm Mix 'D' Asphalt.

150mm G2 Graded crushed stone base compacted to 98% Mod AASHTO density.

150mm Dump Rock.

150mm rip and re-compact in-situ material min CBR >3 @ 90% compacted to 95% Mod AASHTO density.

Undercut unsuitable material and replace with selected material.

- Residential Streets

The following preliminary pavement design is proposed:

30mm Mix 'A' Asphalt.

130mm G2 Graded crushed stone base compacted to 98% Mod AASHTO density.

150mm Dump Rock.

150mm rip and re-compact in-situ material min CBR >3 @ 90% compacted to 95% Mod AASHTO density.

Undercut unsuitable material and replace with selected material.



#### 4.2.2 Stormwater Design

The following design parameters are to be used in accordance with the guidelines:

Design Parameter		
(a)	The Rational Method of design will be used with the following return periods:	
General	- 3	Year storm
Critical Points	- 10	Year storm
Cross Drainage	- 5-20	Year storm
Structures	- 50	Year storm
(b)	Minimum pipe size	- 450 mm - all grades
(c)	Class of pipe	
•	Class 75D	- Mid-blocks
•	Class 100D	- Road crossings & Sidewalks
(d)	Run-off factors	
•	Road areas	- 0,9
•	Roof areas	- 0,9
•	Other areas	- 0,6
(e)	Side inlets, upstream gutter lengths	- According to HJC Forbes
(f)	Minimum inlet length	- 2,44 m
(g)	Maximum inlet length	- According to HJC Forbes
(h)	Inlets, manholes & headwall details	- eThekweni Municipal Standards

The outlet structures, watercourse areas and steep banks will be protected by Reno Mattresses and have energy dissipaters. All cut and fill banks will be grass sodded or hydro seeded to prevent soil erosion.

## 5.0 SANITATION

The site will drain into the existing uMhlathuzana trunk main, and treated at the uMhlathuzana Treatment Works. Sufficient capacity for the additional inflow of 0,6 ML/day has been confirmed, letter attached, by Mr B. Neale of eThekweni Water Services, see Annexure A.

As the trunk main crosses the uMhlathuzana river in various locations, two sewer pipe bridges are required in order to tie-in.

Average Erf Size	: 350m <sup>2</sup>
Number of Erven	: 325
Average Water (litres/day/unit)	: 750
Peak Flow Factor	: 2,5
Stormwater Infiltration Rate (%)	: 15

Using the current Town Planning Layout with a yield of 325 units, an effluent of 243,75 m<sup>3</sup>/day or 88.969 Ml p.a. This equates to an average flow of 1,03 l/sec with an instantaneous peak flow of 2,96 l/sec.

## **4.2 Stormwater**

The majority of the site is bordered by the uMhlathuzana River to the North of the development except for Nazareth Island where the river is to the south.

The eThekweni Municipality has revised its Stormwater Design Manual in May 2008 and all designs and Stormwater Management Plans will be in accordance with their guidelines.

### **4.2.1 Internal Stormwater**

The internal stormwater management system is based on the following principles:

The difference between the pre and post development runoff peaks will need to be controlled / attenuated in such a way that only an equivalent pre development outflow of stormwater runoff will be permitted .

Stormwater will be directed along road surfaces to either discharge through energy dissipaters directly into watercourses, or collected by side inlets at strategic and critical points and directed into sub surface spigot and socket pipes systems. These pipe systems will then discharge via headwall outlets with erosion protection into natural watercourses.

Surface runoff in roads will be contained by the road cross-fall and the kerb. Road cross-falls, where practical will fall towards the cut side of the road in order to accommodate discharging of underground pipes onto the road surface through the kerb. Where it will not always be possible to slope the roads into the cut side of the road it may be necessary to allow for kerbing on both sides of the road to accommodate the drainage.

Servitudes will be provided to accommodate future midblock sub surface stormwater conduits as required.



## **7.0 ELECTRICITY SUPPLY**

eThekwini Electricity are the local authority for the area. They have confirmed in writing that electricity capacity on the existing electrical network is adequate to cater for the development, See Annexure B. No additional bulks will be required. The reticulation will be funded through the EFA. A connection fee of R350-00 will be charged to each site owner, and deducted from the PHB subsidy.

## **8.0 PIPE SLEEVES AND CABLE DUCTS**

Preliminary discussions have taken place with eThekwini Electricity. Once the town planning layout has been finalised further discussions will take place regarding ducting positions.

Telkom will be contacted for ducting requirements once the town planning layout has been finalised.

## **9.0 CONCLUSIONS**

In summary, the project can proceed as the availability of bulk infrastructure has been confirmed by the relevant line departments, subject to the following:

- Preparation of a Stormwater Management Plan
- Preparation of a Traffic Impact Assessment
- Preparation of a Relocation Plan for the existing population.

AUGUST 2018

SIGNATURE: \_\_\_\_\_



**SENIOR MANAGER: DEVELOPMENT ENGINEERING (WEST)**

**DEVELOPMENT ENGINEERING DEPARTMENT  
ENGINEERING UNIT  
ETHEKWINI MUNICIPALITY**

## 5.1 Internal Reticulation

The internal waterborne sewer system will be designed in accordance with eThekweni Waste Water Services standards and operate as a gravity main conveying raw effluent into an existing trunk main, located at various low points along the Umhlathuzana river.

The standards to be utilised are as follows:

Pipe Material	: uPVC	
Pipe Class	: Class 34 (300 kPa)	
Pipe Diameters	: Main Gravity Main	: 160 mm
	: Individual House Connection	: 110 mm
Minimum Grade	: Main Gravity Man	: 1:120
	: Individual House Connection	: 1:60
Maximum Grade	: 1:10 (Anchor blocks required if grade is greater than 1:10)	
Bedding	: Flexible (SANS 1200 LB)	
Manholes	: 1.0m Dia. Precast Concrete (0,75m for head of lines)	
Manhole Spacing	: 80 m (Maximum)	
Minimum Cover	: 600 mm (Midblock)	
	: 1 000 mm (Road Reserve)	
	: 1 200 mm (Road Crossing)	

## 6.0 WATER RETICULATION

eThekweni Water is the water authority for the area, and have advised that if the proposed semi pressure level of service is applied, additional capacity for bulks will not be required. The cost of the water supply is borne by eThekweni Water and recovered through a connection fee for each site. See Annexure C for Bulk Water availability confirmation.

### UNIT DEMANDS

Water Supply	
Description of Consumer	Daily Demand
Subsidised Housing	750 ℓ per unit
Subsidised Housing High density	750 ℓ per unit
Non-Subsidised Housing	1000 ℓ per unit
Hydroponics	1000 ℓ per unit
Industrial grow	-
Business, Industrial and commercial erven per 100 m <sup>2</sup> floor space.	330 ℓ per day
Agricultural collage and agricultural services per 100 m <sup>2</sup> floor space.	330 ℓ per day
Schools	20 ℓ per pupil
Community Halls	70 ℓ per visitor
Bus/ taxi ranks/ railway station	15 ℓ per user
Churches	30 ℓ per user
Clinics	250 ℓ per bed 50 ℓ per user
Public open space and cemetery	15 kℓ per ha

## **ANNEXURES**

