Baseline report- Civil and Bulk services

Roosboom Housing Development

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By: Aspire Consulting Engineers Pty Ltd

Roosboom Housing Development

DESIGN SCHEME REPORT

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1.0 ABBREVIATIONS

kl/day: Kilolitre per day

l/s: Litres per second

ADWD: Average Daily Water Demand

MDWD: Maximum Daily Water Demand

PHWD: Peak Hour Water Demand

INF: Infiltration

SANS: South African National Standards

uPVC: Unplasticized Poly Vinyl Chloride (Plastic pipe)

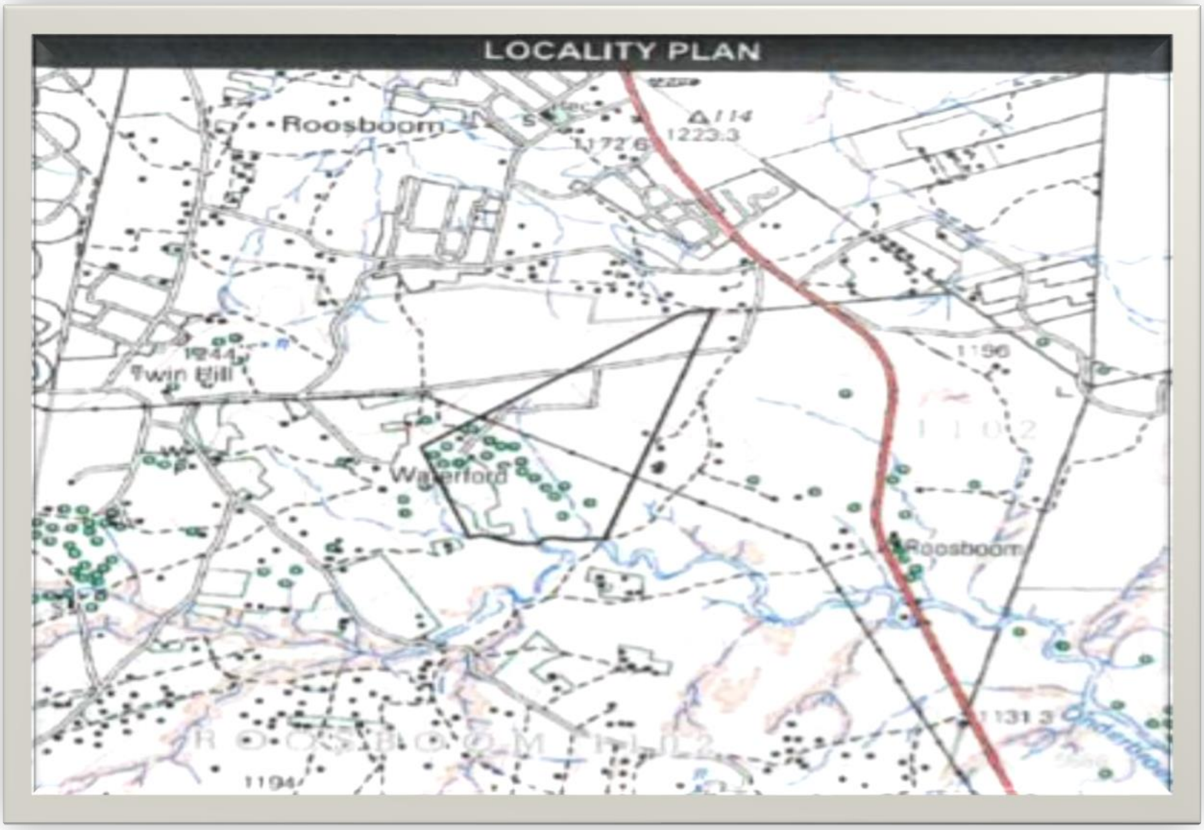
VIP: Ventilated Improved Pit latrines

2.0 INTRODUCTION AND BACKGROUND

The proposed housing development is located in the South Western side of Ladysmith. In accordance with the Government's social upliftment and caring for the vulnerable and previously disadvantaged clearance policy, the Alfred Duma Local Municipality proposes to formalise the clusters of Roosboom communities by providing formal houses and establishing settlement infrastructure such as roads, storm water drainage and improved sanitation to the community.

The site of the proposed development is located within the periphery of Ladysmith - Google Coordinates: 28º39'41.62''S 29º43'06.48''E elevation 1158m. *Refer to Fig.1 below for locality plan*.

Fig. 1 Locality plan



The proposed development consists of 913 new 40m^2 low income structures programme which will be under the umbrella of Alfred Duma Local Municipality. This is as has been shown under the layout drawing located in the Appendix. This report deals with the civil engineering bulk infrastructure, the civil engineering services and will enable the approximate cost thereof.

3.0 GEOTECHNICAL CONDITIONS

Regional geological information indicates that the study area is underlain by three main geological units. In chronological order these include:

- *Quaternary Deposits:* Fine grained sediments and silcrete deposits are depicted on the study area dotted yellow. These deposits typically occur in lower-lying areas near the study area.

  Dolerite: Dolerite (Jd) intrusions are marked across the entire region and are erratic in distribution. The dolerite was verified both on site and in adjacent areas. The dolerite is geologically younger than the sedimentary bedrock materials in the region and intruded through said materials. Where intrusion occurred, the sedimentary host materials often get baked by thermal, contact metamorphism effectively hardening the sedimentary bedrock.

- *Adelaide Subgroup:* The Adelaide Subgroup (Pa) forms part of the Beaufort Group of the Karoo Supergroup. The Subgroup is indicated over much of the study area and regional information suggests that bedrock materials consist of grey mudstone, dark grey shale, siltstone and sandstone.

No fault zones are indicated in the vicinity of the study area.

4.0 TOPOGRAPHY

The general slope of the ground on site is from Northeast to the Southwest at an average gradient of 1 in 18 (5.5%). This slope can be categorised as a category 2 slope (i.e between 1:10 and 1:20) as per the National Housing Programme Subsidy calculation sheet.

Terracing for houses and earthworks will be needed as well as additional stormwater control measures to ensure that the runoff does not lead to erosion will need to be done at detailed design stage. might need to be put in place.

5.0 FLOODLINES

The 1 in 100 year flood lines has been ascertained *(see attached floodline drawing and forms part of the annexures of this report)*. A full topographical and hydrological survey along all the natural water courses that pass through or along this proposed settlement site to confirm that none of the planned dwellings are within these flood lines.

6.0 WATER SUPPLY

6.1 Anticipated water demand

Basing on the information provided for the anticipated development as per the town planning information drawing *(Appendix A),* the water demand for the proposed development will be as follows.

1. Average Daily Water Demand
   913 Residential units ≈(100L/ca/day +10%) x 3.05 ca/unit x 913 units = **306.311 kl/day** or **3.545 l/s**

2. Maximum Daily Water Demand
   913 Residential units ≈1.6 (PF) x ADWD
   = **490.098 kl/day** or **5.67 l/s**

(Source – Water demand estimation and design guidelines manual)

6.2 Current/Existing water reticulation system.

The Alfred Duma Local Municipality has indicated that there is an existing water line running along the local district gravel road which passes through the proposed site *(Refer to Appendix B for Existing services layout drawing)*, with a dedicated 110 mm diameter connection currently supplying nearby facilities.

We had a meeting with officials from the Department of Human Settlements at Alfred Duma Local Municipality and we obtained verbal confirmation that 200m radius stand pipes which are the stipulated minimum standards for rural settlements would be adequate to supply the proposed development for the meantime while we wait for a budget to be availed to upgrade the capacity of the water reservoir which is supposed to supply water to every ERF on the proposed development.

It was also confirmed that the bulk water supply line that passes through the site, has adequate capacity to supply stand pipes spaced at 200m radius from each other within the proposed development.

We recommended that the project be implemented using standpipes placed at approximately 200 metres of each household noting that the project is rural in nature. An option of rainwater harvesting will be explored to augment the water supply to this development. Harvested rainwater will be utilised for all purposes except drinking and cooking.

7.0 SEWERAGE

7.1 Existing sewerage infrastructure

The Alfred Duma Local Municipality confirmed that, currently there is no bulk infrastructure linking the proposed development site appropriate Municipal sewage connections.

7.2 Anticipated sewerage flow

The proposed development will have 913 rural residential units which are expected to generate an average sewerage discharge of;

(100L/ca/day +10%) x 3.05 ca/unit x 913 units = **306.311 kl/day** or **3.545 l/s**

Therefore; average daily flow = 3.545 l/s

Peak Flow **10.192 l/s** (3.545 l/s x 2.5(PF) x 1.15(INF))

Peak Factor 2.5 (PF)

Infiltration 15% (INF)

(Source – Guidelines for Human Settlement Planning and Design)

7.3 Proposed infrastructure

7.3.1 Option 1: Install Ventilated Improved Lined Pit latrines (VIP) Toilets

The Ventilated improved pit latrine system is the most viable means of sanitation for the proposed site considering that the site is remotely located to the centralized waste water treatment site which services the jurisdiction of Alfred Duma Local Municipality.

The top-structure over the pit on this type of toilet system is vented by a pipe over which a fly-screen is fixed. The pit will be lined with concrete to protect the underground water table from any possible form of pollution. The pit latrines can either be constructed as single pit systems or double pit systems depending on the number of people residing in each single unit.

A dry pit latrine ventilated by a pipe that extends above the latrine roof. The open end of the vent pipe is covered with gauze mesh or fly-proof netting and the inside of the superstructure is kept dark. This system is the most economical to install and operate in this area, considering that the site is in a rural set up and currently there is no adequate water supply to each ERF.

7.3.2 Option 2: Install sewage lagoons

Installing sewage lagoons is also another alternative that can be used as a sewage disposal method for the proposed development. A sewage lagoon/effluent pond is a large pond into which the sewage or effluent from the sewage system flows.

The sewage and effluent are broken down by germs in the lagoon. The sun and wind play an important role in the working of the lagoon. They provide light, warmth and oxygen to the water. This is necessary for the growth of the bacteria in the water.

The light, warmth and oxygen also aid the growth of algae in the water. The algae give the lagoon its greenish flecked colour. The algae helps bacteria to break down the sewage and effluent.

The wind helps with the evaporation of the water and serves to get oxygen into the water. It also creates waves which help stop insects from breeding and living in the water. Disease-causing mosquitoes, for example, need still water to breed.

For a lagoon to be able to break down the sewage or effluent properly and to be a healthy place it must meet the following requirements:

- It must not be more than 1 m deep
- The banks need to be sloped at approximately 15 to 20 degrees and made of concrete, gravel or rock. This stops the wave action from eroding (breaking down) the banks
- There must be no grass, trees or other vegetation on the banks or surrounding area which would stop the sun and wind action needed by the lagoon
- The water must be free of vegetation or objects which stop the lagoon's surface wave action or create still patches
- It must be surrounded by a high fence with a lockable gate to keep children and animals out

This application will require an area of approximately 200 m^2 at the lower end of the proposed site.

7.3.3 Option 3: Install a new bulk Infrastructure line.

Another viable alternative even though it will be costly, will be to install a new bulk sewage line linking the proposed site to the existing treatment works which is located further from the proposed site since the site is a rural location. Depending on the location of the site in relation to the existing treatment works and the feasible general slope which this pipe must adopt, the line might need to be pumped.

This line will however not be exclusive to the proposed development and will have to be sized to accommodate flows from existing and future development located along its route.

7.3.4 Option 4: Install septic tanks

Septic tanks are the most widely used onsite wastewater treatment option all over the world. This system of on-site treatment of wastewater is gaining popularity also within the Sub-Saharan Africa region with septic tanks being adopted for treatment prior to disposal of home wastewater.

Septic tanks are buried, watertight receptacles designed and constructed to receive wastewater from a home, to separate solids from the liquid, to provide limited digestion of organic matter, to store solids, and to allow the clarified liquid to discharge for further treatment and disposal. Settleable solids and partially decomposed sludge settle to the bottom of the tank and accumulate. A scum (including fats and greases) rises to the top the liquid is allowed to flow through an outlet floating scum layer. Proper use of baffles, against scum outflow.

Septic tanks are normally the first component of an onsite system. They must be followed by polishing treatment and/or disposal units. In most instances, septic tank effluent is discharged to a soil absorption field where the wastewater percolates down through the soil. In areas where soils are not suitable for percolation, septic tank effluent can be discharged to mounds for treatment and disposal, or to filters or lagoons for further treatment. Septic tanks are also amenable to chemical addition for nutrient removal.

7.3.5 Option 5: Install Intermittent sand filters

Intermittent sand filtration may be defined as the intermittent application of wastewater to a bed of granular material which is under-drained to collect and discharge the final effluent. This is one of the oldest methods of wastewater treatment known. Intermittent sand filtration, if properly designed, operated, and constructed will produce effluents of very high quality.

Intermittent sand filtration is well suited to on-site wastewater treatment and disposal. The process is highly efficient yet requires minimum operation and maintenance. Normally, it would be used to polish effluents from septic tank or aerobic treatment processes and would be followed by disinfection (as required) prior to reuse or disposal to land or surface waters.

Intermittent sand filters are beds of granular materials 61 to 91 cm deep and underlain by graded gravel and collecting tile. Wastewater is applied intermittently to the surface of the bed through distribution pipes or troughs. Uniform distribution is normally obtained by dosing so as to flood the entire surface of the bed. Filters may be designed to provide free access (open filters),or may be buried in the ground (buried filters). A relatively new concept infiltration employs recirculation of filter effluent (recirculating filters). The mechanisms of purification attained by intermittent sand filters are complex and not well understood even today. Filters provide physical straining and sedimentation of solid materials within the media grains. Chemical sorption also plays a role in the removal of some materials. However, successful treatment of wastewaters is dependent upon the biochemical transformations occurring within the filter. Without the assimilation of filtered and absorbed materials by biological growth within the filter, the process would fail to operate properly. There is a broad range of trophic levels operating within the filter, from the bacteria to annelid worms. Since filters entrap, sorb, and assimilate materials in the wastewater, it is not surprising to find that the interstices between the grains may fill, and the filter may eventually clog. Clogging maybe caused by physical, chemical, and biological factors. Physical clogging is normally caused by the accumulation of stable solid materials within or on the surface of the sand. It is dependent on grain size and porosity of the filter media, and on wastewater suspended solids characteristics. The precipitation, coagulation, and adsorption of a variety of materials in wastewater may also contribute to the clogging problem in some filter operations.

Intermittent sand filtration is well adapted to onsite disposal. Its size is limited by land availability. The process is applicable to single homes and clusters of dwellings. The wastewater applied to the intermittent filters should be pre-treated at least by sedimentation. Septic tanks should be required as a minimum. Additional pre- treatment by aerobic biological processes normally results in higher acceptable rates of wastewater application and longer filter runs. Although extensive field experience is lacking to date, the application of pre-treated greywaters to intermittent sand filters may be advantageously employed.

Site constraints should not limit the application of intermittent sand filters, although odours from open filters receiving septic tank effluent may require isolation of the process from dwellings. Filters are often partially (or completely) buried in the ground but may be constructed above ground when dictated by shallow bedrock or highwater tables. Covered filters are required in areas with extended periods of subfreezing weather. Excessive long-term rainfall and runoff on submerged filter systems may be detrimental to performance, requiring appropriate measures to divert these sources away from the system.

7.3.6 Option 6: Install aerobic treatment units

Biological wastewater treatment processes are employed to transform dissolved and colloidal pollutants into gases, cell material, and metabolic end products. These processes may occur in the presence or absence of oxygen. In the absence of oxygen (anaerobic process), wastewater materials may be hydrolyzed and the resultant products fermented to produce a variety of alcohols, organic acids, other reduced end products, synthesized cell mass, and gases including carbon dioxide, hydrogen, and methane. Further treatment of the effluents from anaerobic processes is normally required in order to achieve an acceptable quality for surface discharge. On the other hand, aerobic processes will generate high-quality effluents containing a variety of oxidized end products, carbon dioxide, and metabolized biomass.

Biological wastewater treatment is normally carried out in an open culture whereby a great variety of microorganisms exist symbiotically. The system is, therefore, very versatile in carrying out a variety of biochemical reactions in response to variations in input pollutants as well as other environmental factors.

Extended aeration processes are necessarily more complex than septic tanks and require regular operation and maintenance. The plants may be buried or housed on site but must be readily accessible. The aeration system requires power, and some noise and odour may be associated with it. There are no significant physical site conditions that limit its application, although local codes may require certain set-back distances. The process is temperature-dependent and should be insulated and covered as climate dictates.

8.0 STORM WATER DRAINAGE.

Currently there is no storm water drainage system in close proximity to the proposed site except some unlined drains which run parallel to the existing gravel roads surrounding the proposed site.

The stormwater management objective is to control the flow of stormwater with the use of an armorflex stormwater channel system that runs around the township and that will discharge into attenuation ponds strategically positioned to suit the topography of the site and then eventually released into nearby river streams adjacent to the site. The armorflex stormwater channels are critical in minimising further erosion from stormwater runoff.

9.0 SOLID WASTE MANAGEMENT.

Due to the large number of residential stands being introduced on the proposed township there is bound to be domestic waste generated in each household. Though, solid waste generated in rural areas is predominantly organic and biodegradable, it will become a major problem if the waste generated is not segregated in-situ. Inconsiderate littering causes poor environmental sanitation resulting in unhealthy quality of living. Therefore, domestic-refuse should be handled responsibly. In order to manage waste in a desirable way, there should be a functional waste management system in place. Without a functional waste collection and disposal system there will be detrimental effects to the environment at large.

9.1 Proposed Solid Waste Management Strategy.

Each household must be provided with three-buckets–Green, Blue and a Redone.

(a) The Green bucket will be for disposing of kitchen refuse, leftover food and other wet waste;

(b) The Blue bucket will be for keeping dry wastes; and

(c) the Red bucket is for keeping hazardous wastes like batteries; fused bulbs etc.

The wet waste in the Green buckets shall be collected daily morning (or morning and evening) as decided by the local authority's refuse collection department. Collecting two times a day (morning and evening) renders handling easy. That is when the waste is still fresh and has not started emitting odours, effective segregation becomes easier, than handling wastes that are stale and decayed. The dry waste shall be collected separately, and the hazardous waste shall be collected from households once a month, for instance, on the 5thday of every month. If more hazardous waste is found, collection can be made once a fortnight. The chance of hazardous waste being more is likely to be remote considering that the development will be in a peri-urban area.

The above-mentioned refuse management strategy will be complimented by introducing a recycling programme to recycle solid waste that is recyclable.

10.0 EXTERNAL ACCESS ROADS AND UPGRADING

The main access to the proposed site is primarily through a local district gravel road which links to a formal tarred provincial road **(R103)** *(Refer to Fig. 1 Locality plan).* This access will not be affected by the development within the proposed site precinct and will be maintained as main access to the intended development.

It is envisaged, subject to the recommendations of an approved traffic impact study, that the existing access road be paved and the access will be formalised, this will be done by our firm at the detailed design stage of the process.

11.0 CIVIL ENGINEERRING SERVICES

11.1 Design criteria

The appropriate SANS codes which deal specifically with the application of National building regulations and technical specifications for civil engineering designs(i.e SANS 10400 and SANS 1200 respectively) in conjunction with the concerned local authority by-laws and regulations should be adhered to in the design of the civil engineering services for the proposed site.

11.2 On-site sewer disposal system design

If the VIP toilets are to be adopted, the following design considerations must be taken into account for the efficient functionality of the system:

- The toilet design should allow for the possibility of the pits to be emptied in order to achieve longer service life on the latrine units
- Raising the cover slab above the ground level by a single course of brickwork
- Lining the pit walls is very essential in order to provide structural stability to the latrines as well as protecting the underground water table
- Alternating twin pit VIP latrines should be used where appropriate and cost–effective.

11.3 Storm water drainage

The proposed storm water drainage for the development should be designed generally in accordance with SANS 1200 and the requirements of Alfred Duma Local Municipality. Where ever precast concrete pipes will be adopted in the storm water design they should be Class 100D within the development. All pipes should be interlocking joint pipes to SANS 677. A minimum pipe diameter of 450 mm should be adopted for pipes.

Manholes, junction boxes, grid and kerb inlets should be designed generally in accordance with the requirements of the local municipality. Discharge of storm water run-off should be to the nearby river stream that flows adjacent to the site.

11.4 Water reticulation

Depending on the confirmation that a functional bulk water line exists, if a water reticulation system on the proposed site is to be connected to that bulk line, the proposed reticulation system should be a combined system supplying both potable water and adequate fire hydrant points to supply water for fire protection services.

The water connection should consist of 110 mm diameter class 16 uPVC minimum size water pipes laid out in accordance to SANS 966. A cast iron isolating valves and chambers where ever necessary should be provided to enable the water reticulation system to be turned off should maintenance be required. Standpipes placed should be placed at radius of approximately 200 metres of each household as an interim measure while awaiting for funds to be availed to upgrade the capacity of the nearby water reservoir to supply water to every stand.

12.0 CONCLUSIONS

The above civil and bulk services report is to be read in conjunction with the appropriate figures and other attachments in the appendices.
Please do not hesitate to contact us if clarity is needed on any of the above mentioned items.

Z. Karim

Civil/Structural Engineer

12.0 APPENDIXES

APPENDIX A- TOWNSHIP LAYOUT

APPENDIX B- EXISTING SERVICES LAYOUT