PROPOSED DEVELOPMENT OF A HUMAN SETTLEMENT/RESIDENTIAL TOWNSHIP ON PORTION 437 AND PORTION 502 OF THE FARM ROOSBOOM 1102GS, ALFRED DUMA LOCAL MUNICIPALITY - LADYSMITH KWAZULU NATAL

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Compiled for:

Compiled by:

Ecological & Environmental Consultants
(CK 2000/076445/23)

PO Box 441037
LINDEN
2104

Tel. (011) 782 - 3428
Fax: (011) 888 - 9588
Email: info@ecoassessments.co.za

Report Date: FEBRUARY 2020
Our Reference: 1250/17
Reference: DC23/0007/2019 - KZN/EIA/0001155/2019

EXECUTIVE SUMMARY

Introduction

The Alfred Duma Local Municipality proposes to develop a human settlement in Roosboom, close to the town of Ladysmith in KZN (Contract No. DP and HS 12/2016). The settlement serves to assist in alleviating the tremendous housing shortage within the Municipal Area. These same challenges reflect the priority of housing requirements in large areas across the broader South African landscape.

This project has been awarded to Shatsane Systems Solutions (PTY) LTD T/A SSS Invest.

A Scoping Report / EIA application was lodged with the KZN Department of Economic Development, Tourism and Environmental Affairs on the 05th June 2019.

The Final Scoping Report was lodged on the 22nd July 2019 and the EDTEA approved the scoping report and Plan of Study for EIA on the 23rd August 2019.

The Draft EIA report was provided to registered IAP's and State Departments on the 28th November 2019. IAP's and State Departments had until the 21st January 2020 to provide comments.

EDTEA further extended the date by when the Final EIA report had to be submitted to the 25th February 2020 following a request for extension lodged on the 17th October 2019.

This report comprises the FINAL EIA report that seeks to detail the environmental features and characteristics of the site, describe the proposed development in detail and consider the potential environmental impact of the development. This has also included compiling an Environmental Management Program report that includes several mitigation measures and environmental management strategies that minimize the impact of the development on the environment.

Details of the Application

The development is proposed to encompass the establishment of a human settlement / residential township on area of 81hectares located on Portions 437 and 502 of the Farm Roosboom 1102GS (Ladysmith KZN). The proposed development was to include the following elements:

- Approximately 1000 Residential 1 stands (average size of 300m^2 in extent),
- Erven for Business 1 land use, Community Facilities that include churches, crèches and Educational uses;
- Public Open Space and
- Roads.

Various infrastructure link services (roads, water, sewage, storm water and electrical supply) will need to be constructed on or across the site.

The following list of activities in terms of the EIA Regulations of 2014 (as amended) is likely to be triggered by the development:

GN 327 (07 April 2017)	11	Not triggered
GN 327 (07 April 2017)	12	The construction activities will include the development of attenuation ponds, weirs, low water bridges, storm water outlet structures and other infrastructure with a footprint greater than 100m^2 within 32m of the water courses. The site lies adjacent to an urban area. This infrastructure will be necessary to manage and control the run off of storm water across the site and protect the site from erosion or localized flooding. The exact points and positions of the SWMP will be provided in the EIA phase of the project.
GN 327 (07 April 2017)	19	The construction activities will include excavation of an accumulated volume of more than 10 cubic meters of soil and sub-soil to form the foundations for the development of attenuation ponds, weirs, low water bridges, storm water outlet structures and other infrastructure with a footprint greater than 100m^2 within 32m of the water courses. The site lies adjacent to an urban area.
GN 327 (07 April 2017)	24	The proposed township includes the construction of several internal and link gravel roads to provide access to the units. The internal roads will also need to link to the existing gravel roads that bisect the residential areas of Roosboom that lies adjacent to the site.
GN 327 (07 April 2017)	25	Not triggered
GN 327 (07 April 2017)	28	The development will create a residential township larger than 1 hectare in extent on land that has not formally been used for agriculture since 01 April 1998 and that lies adjacent to an urban area. The site however has not been previously developed.
GN 325 (07 April 2017)	15	The construction activities and establishment of the township will clear an area greater than 20 hectares of indigenous vegetation.

A variety of specialist assessments were used to describe and evaluate the potential impact of the development, and its alternatives, on the site and surrounding areas.

These included -

Geotechnical Assessment to investigate & determine the underlying geology and soil conditions as well as identify areas suitable for or that offer a constraint to the development of the township.

The site comprises an undulating landscape of low hills and valley bisected by a non-perennial watercourse that drains into a non-perennial river in the south of the site.

The geological investigation for the site fids the site is underlain by sedimentary bedrock materials of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. The sedimentary materials have been intruded by dolerite dykes in places and covered by quaternary and alluvial deposits in lower lying areas.

Soil profiles across the site are variable but generally consist of colluvial cover overlying residual profiles of shale, sandstone and/or dolerite materials. Areas of

bedrock outcrop occur on site. Perched groundwater or seepage water was not encountered in trial holes, but it is expected that such water may occur on a seasonal basis and affect the proposed development adversely. The study area is divided into six zones, namely **R or S/R**, **H1/R or S/H1/R**, **S1**, **H1-H2 or S/H1-H2, H3 and H2/H3**. Detailed site and stand zoning must be verified during a phase two investigation. The zoning must also be revised once flood line and groundwater assessments have been completed. Excavations are expected to be affected by seasonal groundwater influx and/or perched water levels. Conditions of clayey excavation may occur in most residual materials, while bedrock materials may need to be excavated or blasted. Some soil materials on site proved to be corrosive, mostly on account of high soil conductivity properties. The area is not subject to undermining.

The area is not subject to dolomite related instabilities. A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.06g to 0.10g may take place once in 50 years. Insect nesting, such as ants and termites, was encountered sporadically throughout the site. Cognizance must be taken of the fact that clusters of eucalyptus trees occurred on the western parts of the site. Erosion dongas were found on site and are likely related to proven dispersive soil materials.

Generally the soil profile and geotechnical condition is considered to be Favourable and/or will require mitigation measures on Intermediate Development Potential soils. Dispersive soils will need to be well managed to mitigate impacts of erosion and storm water run off.

Geohydrological Assessment to assess the risk and impact of the development on the underlying aquifer and ground water conditions. This assessment further explored risks of the proposed sewage designs on the ground water condition and characteristics.

Regionally the site is located on a water divide whereas the furthest parts on the northern boundary on portion 437 drains to the north and the majority of the remainder of portion 437 drains towards the south. Drainage on portion 502 is expected to be to the north towards the Onderbroekspruit.

The site is underlain by three main lithological units that consist of quaternary deposits consisting of fine grained sediments, dolerite intrusions and the sedimentary rocks of the Adelaide Subgroup which forms part of the Beaufort Group of the Karoo Supergroup. The Adelaide subgroup bedrock materials consist of grey mudstone, dark grey shale, siltstone and sandstone. No fault zones are indicated in the vicinity of the site.

The geotechnical studies (Soil Kraft, 2017 and 2019) revealed the majority of the site is underlain by limited colluvium overlying bedrock (sandstone and shale) and colluvium overlying residual soils with shallow bedrock in places. The site is underlain by an intergranular and fractured type of aquifer with average borehole yields of between 0.1 and 0.5 l/s.

The aquifer is classified as a minor aquifer, with medium susceptibility to contamination and moderate vulnerability. In addition to the published sources of information a qualitative assessment of the sensitivity and vulnerability of groundwater and surface water in the vicinity of the site was undertaken.

Groundwater sensitivity at the site is classified as high as groundwater is utilized in the vicinity of the site to augment the municipal water supply which was reported to

be erratic by local resident. The vulnerability of the groundwater is also considered to be high as static groundwater depth was less than 10 m bgl and overlain by highly permeable or fractured materials. The surface water sensitivity is considered to be moderate as the surface water bodies in the region potentially has deteriorated water quality. Surface water vulnerability is considered to be high as the perennial Onderbroekspruit cuts through the project site at the border between farm portion 437 and 502. The direction of groundwater flow is expected to emulate the topographical gradient which for the majority of portion 437 slopes towards the south. As the site is located on a water divide groundwater flow is expected to flow to the north on the northern perimeter of portion 437. As for portion 502 groundwater flow is anticipated to flow towards the north towards the Onderbroekspruit. Considering the local geology and climate there is also a high likelihood that a perched water table could develop above the bedrock interface during the rainy season. As the current assessment was undertaken during the end of the dry season the presence of a perched water table could not be verified. The geotechnical investigation (Soil Kraft, 2017 & 2019) also commented on the potential presence of a perched water table during the rainy season.

The vulnerability of the groundwater was considered to be high as static groundwater depth was less than 10 m bgl (as measured in HBH3) and overlain by permeable or fractured materials. A VIP pit latrine with a containment pit system is proposed for the development. Such a system should typically have minimal hydraulic output into the receiving environment and therefore minimal risk of contamination if operated and maintained properly.

The overall risk for the development to contaminate the underlying groundwater regime was therefore considered to be medium and some precautionary measures will have to be implemented. It should also be noted that the underlying aquifer is of strategic value to the local community as a source of water and therefore requires a measure of protection from anthropogenic impacts.

Ecological Assessment to evaluate the impact of clearing the site on the fauna and flora of the study area.

The area where the township site is located consists of natural land and supports a variety of natural fauna and flora. The area is however not highlighted as a high priority conservation area, neither as an area where there is a major concern for sensitive natural species which can be impacted upon. The assessment of the site indicated that sensitive species, should they be present, would more likely be associated with the rocky areas than the grassland areas.

Subsequently it is advised that the rocky areas as well as the stream areas be excluded as development areas, as these habitats will allow for continued use of the site by faunal and floral species presently making use of the site for the habitat and food requirements.

The value of the open land/open spaces for humans and nature will have to be conveyed to future residents to ensure the sustainable use of these areas. This can be done through simple signage or environmental education through nearby schools and community centres.

In summary, there are no ecological aspects that would render the site unsuitable for development, if the more sensitive habitats are left undeveloped and protected within the site layout plan.

Watercourse and Wetland Assessment was used to locate and delineate likely water courses on the site as well as to assess the impact of the development on the functioning of the aquatic resources.

The conclusions and recommendations from the wetland/watercourse assessment arising from the study indicate that there are a number of watercourses on site, including semi-perennial streams and drainage lines, all of which were delineated.

The main watercourse is the Onderbroekspruit, which flows from west to east in the southern area of the study site. All watercourses are viewed as having a sensitivity rating of 'high sensitivity'. The township development will have an impact on the inflow, interflow and recharge of the watercourses in the study area. The increase in hard surfaces, impediments (houses, roads, etc.) will have a big impact on the present natural flow and movement of water through the study site and larger system, particularly in terms of surface storm water flow and shallow sub-surface drainage and movement. Erosion and gully formation is a major problem in the region and study site and must be prioritized during planning and construction.

The most sensitive area in terms of potential negative impacts on the water environment is the semi-perennial stream flowing north to south down the middle of the site and into the Onderbroekspruit. Aquatic monitoring of all watercourses is required during the construction phase. A water use licence application (WULA) process is required for the project, as there is construction through watercourses (in the top north of the site) and within 500m of wetlands.

Buffer zones (no-go areas) have been recommended around the watercourses. A 50m buffer zone (no-go area) has been recommended around the Onderbroekspruit, as it is the major water arterial through the area, while narrower 32m buffers have been recommended around the smaller, less significant watercourses. No development may take place within the recommended buffer zones, with the exception of very limited recreational structures for public open spaces. It is recommended that locally indigenous thorntrees be planted along some of the streams, in open public spaces and in areas with high erosion potential. A site-specific rehabilitation plan for all watercourses is required.

A site-specific storm water management plan is required. The plan must address outflow points into watercourses (velocity, erosion, etc.). Furthermore, outflow must be spread along the length of watercourses and must not simply be concentrated and released at one point at the lowest downstream area. In other words, flow of water into the entire length of watercourses must be addressed and managed to maintain the integrity of the watercourses.

There are no fatal flaws and the project may proceed, but only with the implementation of recommended mitigating and management measures. It is opinion of the wetland specialist that the proposed project (activity) and related activities should be authorised. However, all watercourses should be avoided and all recommended mitigating measures must be implemented and form part of the EMPr.

Cultural Historic Assessment compiled by a professional scientist to determine if any cultural historic features occur onsite or in the surrounding area that may be impacted upon.

The cultural historic study highlighted that the general area under investigation has a wealth of heritage sites dating from the Stone Age to the recent past (e.g.,Vinnicombe, 1976, Klein 1977, Huffman 2007, Anderson 2015 a and b). During the survey of the study area, several features were recorded.

Key findings of the study are:

- Demolished ruins of several structures were recorded. The structures' potential to contribute to aesthetic, historic, scientific and social aspects are low, but sites like these are known to contain unmarked graves, usually of stillborn babies. In which case the sites would be of high social significance;
- Two isolated find spots were recorded consisting of a broken lower grinder and an undecorated ceramic sherd. No other features were found in associated and these features are therefor of no heritage significance;
- A number of locations were identified across the survey area interpreted as grave sites. Some of these features are only marked by stone packed cairns and the possibility exists that not all of these could be graves but is handled as such until it is proven otherwise;
- The area is characterised by informal grazing and rural township developments. The proposed development will not impact negatively on significant cultural landscapes or viewscapes as the development is in line with the surrounding land use. During the Public Participation process conducted for this project, no heritage concerns were raised.

The proposed project will impact directly on heritage resources with the highest impact being on grave sites. Three alternative lay outs were assessed and if the recommendations in this report are adhered to all the alternatives are acceptable from a heritage point view with the Draft Final lay out being the preferred option.

To mitigate the impact of the proposed project on the recorded heritage resources the following recommendations apply as a condition of authorisation (part of the EMPr) and based on approval from AMAFA.

- Confirmation of grave sites in the study area through a social consultation process that addresses the issue of unmarked graves associated with structures as well as stone cairns currently interpreted as possible graves;
- Graves located in future and known graves should ideally be retained *in situ* in open spaces;
- Implementation of a chance find procedure for the project as outlined;
- A Site development plan should be compiled for the development;
- Site specific recommendations should also be adhered to as listed in the EMPr.

Paleontological Impact Assessment that sought to describe the current status and sensitivity of the paleontology (fossiled rocks and geological features) on the site as well as determine the potential impact of the development to these features.

An independent paleontological assessment was conducted by Prof Marion Bamford (2019) that concluded as far as the palaeontology is concerned the project can proceed based on the implementation of a fossil chance finds procedure (Bamford 2019).

Town Planning Memorandum that motivates the proposed development and indicates the relevant development controls as well as need and desirability for the development.

The KZN Provincial Master Spatial Plan aims to translate the Provincial Growth and Development Plan (PGDP) into a detailed implementation plan for assisting with the identification of sustainable land for housing delivery in the province.

The human settlements targets for Uthukela District Municipality include spatial intervention such as increasing the housing capacity of the municipality and densification at main centres to meet service delivery needs. The Roosboom area is one of the main centres identified for densification within Uthukela. Additional, the Roosboom area forms part of the areas identified as provincial human settlements investment focus areas.

The Provincial Growth and Development Strategy commits the provincial government to ensuring that all households within the province have secure residential tenure and access to basic utility services.

The Roosboom Housing Project is a response to these provincial policy directives and provides for their attainment within the Alfred Duma Municipal area.

The Roosboom Housing Project is identified in the Alfred Duma Municipality's Integrated Development Plan (IDP). The IDP, as a key strategic overall guiding framework of the municipality, identifies a need to facilitate the provision of adequate housing to all deserving citizens. Therefore, the proposed development can be seen as way of giving effect to one of the municipality's key strategic and long terms objectives. The proposed development forms part of the municipality's mission to ameliorate the standards of living within its area of jurisdiction by providing housing and basic service needs.

The municipality is cognizant of the fact that it has to provide housing that is sustainable and promotes easy access to opportunities. This is further emphasised in the municipality's RSDF.

The municipality's Spatial Development Framework (SDF) identifies the Roosboom area as one of the areas that require housing interventions within the municipality.

The project area falls within the broadest development vision of the municipality with regards to ensuring and facilitating the development of sustainable human settlements.

The SDF identifies Roosboom as a tertiary node within the municipality. This essentially locates the project area within the broader sphere of influence within the municipality.

Civil Services (Bulk Water and Sewer) Scheme Report compiled by a professional engineer to quantify the peak loads, available capacity and means of supply of the relevant services for access, water supply and sewage disposal.

Water
An existing Bulk Water line bisects the property and can service the site. A link connections can be made into this line and from there various pipes connected to service units. The internal water pipes will be located within the road reserve of the

various internal roads. Some of these pipes will need to cross the watercourse and/or sensitive areas (i.e. rocky ridge). This impact is likely to be of Moderate Significance and will require detailed planning and mitigation measures.

Sewerage
The site does not have access to a waterborne outfall sewage solution and n bulk facilities occur in proximity to the site. A cost:benefit investigation concludes that a VIP Laterine offers the most cost effective and sustainable option to service the individual units at this time.

The envisaged system is not likely to impact significantly on the ground water environment as it will be a re-enforced concrete lined and sealed pit system. The application of a bioenzyme (i.e. Sannetree) will assist is reducing the volume of accumulated sludge and extend the life of the pit to 25 years,

Roads
The development will include a number of internal roads to provide access to individual units and cater for transport and movement across the site and into adjoining areas and towns. These roads will be unsurfaced gravel roads of approximately 3m width. Pavements will not be paved.

Electrical Outline Scheme Report compiled by a professional engineer to quantify the peak loads, available capacity and means of supply of Power to the site.

Electricity
The site is bisected by various bulk power lines that include a 275KvA line that supplies parts of Roosboom with an 11KvA network. This network will be tied into to provide power to each individual unit. This will be achieved via standard Eskom reticulation systems that include wooden poles and pole transformers. Adequate capacity is likely to exist for Eskom supply and supply for the First Phase of 557 units has been confirmed.

Where power supply needs to cross sensitive areas, this will follow the proposed road network in order to minimize impacts on the environment. The anticipated impact from using pole transformers is likely to be of low significance owing to low ecological footprint for each wooden pole.

Traffic Impact Assessment to determine the impact on the road network surrounding the site and evaluate requirements to access the site.

Based on assessment of the existing and planned future major road network, traffic counts, a traffic analysis and capacity analysis of road links in the study area, the following concluding remarks are relevant. The proposed development is expected to generate 512 and 507 trips during the AM and PM peak hour respectively. The master plan provides a framework and ensures that the proposed development is sustainable from a traffic engineering point of view. The proposed development will have one access off the external road network (Gravel Road). In terms of accesses to various sites, it is proposed that each site will gain access from new internal Class 4 and Class 5 roads. It is proposed that the existing intersection of R103 and D637 be reconfigured as follows:

- The R103 and D637 should comprise of a 90 degrees T-Junction
- Dedicated right-turn lane (60,0 m) on the southbound direction
- Dedicated left-turn lane (60,0 m) on the northbound direction

- Dedicated right-turn lane (60,0 m) on the eastbound direction
- Single lane in each direction for all the legs of the intersection

The proposed township development will comprise of an intersection that will provide access and connect with the existing gravel Road and will be provided as follows:

- Dedicated right-turn lane (30,0 m) on the northbound direction
- A shared through and left turn lane on the northbound direction
- A receiving lane on the northbound direction
- Dedicated right-turn lane (30,0 m) on the eastbound direction
- A shared through and left turn lane on the eastbound direction
- Dedicated right-turn lane (30,0 m) on the southbound direction
- A shared through and left turn lane on the southbound direction
- A receiving lane on the southbound direction
- Dedicated right-turn lane (30,0 m) on the westbound direction
- A shared through and left turn lane on the westbound direction
- Minibus taxis and buses were observed operating along the surrounding road network.
- There is an existing bus / taxi layby at the intersection of R103 and D637.

It is recommended that the main Class 4 link road within the proposed development have public transport lay-bys in the form of bus / taxi stops at appropriate locations within a maximum walking distance limited to 450,0 m.

It is recommended that a common minibus taxi rank be provided which will serve the proposed township development.

In order to ease and formalise the movement of pedestrians between the site accesses and the recommended lay-bys, it is proposed that 2,0 m wide paved (or dust free) sidewalks be constructed along at least one side of all Class 4 roads within the proposed development. It is also recommended that 2,0 m wide paved (or dust free) sidewalks be constructed along site boundaries of schools and commercial / business and retail nodes.

To improve pedestrian safety, it is proposed that safe pedestrian crossings be implemented at suitable positions on the internal Class 4 roads near schools, commercial / business and retail nodes. This will be addressed in separate traffic impact studies.

From a traffic engineering perspective, the proposed development is thus regarded as feasible and sustainable and is therefore supported.

Storm Water Management Plan compiled by a professional engineer to determine the storm water run off peak and how the relevant run-off can be accommodated to ensure that post-development run off is the same as pre-development run off.

Stormwater
The development includes constructing units of approximately 50m^2 on erven of 300m^2. The development further includes the use of gravel roads and vegetated pavements. Consequently the storm water run off peak flows from the site are far lower than would normally be expected from an urbanised site. Nevertheless, the transformation of the greenfields site will lead to an increased run off that will need to be attenuated. In addition, the weak soil profile exposes the site to erosion risks.

The proposed storm water management plan includes the construction of various natural earth attenuation ponds. Each erf will be platformed and shaped to minimize storm water run off. Run off will then flow in armouflex channels that will serve to slow the water flow as well as increase permeability into the soil. The channels will eventually drain into an attenuation pond. The outflow structure at each release point will include anti erosion measures to prevent scouring of the soil surface and the slow release of the water. Water will drain to the low point and finally drain into the watercourses.

Wherever the contours allow for it, the release point of the storm water (i.e. headwall) is located above the 1:100 year flood line level. However, certain instances require that the headwall be located below the 1:100 floodline. These structures however are relatively small and will not individually impact significantly on the environment.

Cost:Benefit Analysis for Sewer Options to evaluate alternative options to service the sewage needs of the proposed development including the feasibility of such a service the cost:benefit to the environment.

Various sewer options were considered in the impact assessment phase of the project, as required. The preferred option, following and evaluation of engineering costs:benefit indicated that the VIP laterine (a modification of the Ventilated Improved Pit Laterine) offers the Best Practicable Environmental Option for providing sewage services to the site.

Options that were considered included the following -

*Install Ventilated Improved Pit latrines (VIP) Toilets (**Preferred Alternative**)*

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.

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.

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.

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.

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.

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.

Pour-flush latrine with containment pit

This type of latrine is recommended where there is adequate water in the community for flushing and where there is a Masterplan in place to incorporate a water-borne sewerage system to service the proposed development as this could easily be converted into a water-borne sewerage system.

A Pour-flush latrine with a containment pit is installed with a pan with a water seal (a U-shaped conduit partly filled with water) in the defecation hole. This overcomes the problems of flies, mosquitoes and odour. After use, the latrine is flushed by pouring water into the pan. The concrete floor slab with the pan is either on top of the containment pit (direct system) or a short distance away (offset system).

Pits are lined with concrete to retain the waste as well as to provide the required structural integrity to retain the required depth of earth material surrounding the containment pits.

The containment pit will be emptied by honey sucker trucks at regular intervals to prevent spillage, overflowing and unhygienic conditions.

Alternative Assessment

The EIA process examined two (2) layout alternatives as well as the No Go Option.

The proposed/preliminary development option

The proposed (preliminary) layout indicates the following key land uses and development activities.

Landuse	Erf Number	No. of erven	Area	Percentage
Residential 1	1 - 1112	1112	42.9813	52.97
Community Facility - Creche	1113 - 1114	2	0.2929	0.36
Community Facility - Church	1115 - 1118	4	0.4807	0.59
Business 1	1119	1	0.3044	0.38
Public Open Space	1120 - 1129	10	18.6206	22.95
Roads			18.4615	22.75
Total		1129	81.1415	100

The development will require the clearance of indigenous vegetation, the creation of various platforms upon which units will be constructed and the installation of municipal services including piped water, on-site sewage containment, electrification, unsurfaced (gravel) access roads.

Run off from the development areas will be controlled and directed into local storm water berms, culverts, gulleys and attenuation structures to reduce the post development peak flow to acceptable levels. These systems may partially impact on the existing water resources occurring on site.

This layout was rejected following specialist investigation as a number of sensitivity features would have been directly impacted upon. The layout inadequately considered the 1:100 year flood line, spanned across several cultural historic as well as wetland/water course areas and failed to consider the full extent of the ecological sensitivities on the site.

Preferred Layout Option (Alternative 1)

The preferred (Alternative) layout differs quite significantly to the proposed layout (as indicated in the Final Scoping Report) as the preferred layout eliminates direct impacts on several sensitive areas and seeks to ensure that the development is more sustainable.

The development entails the establishment of a human settlement / residential township on the site.

A preferred layout indicates the following key land uses and development activities.

Landuse	Erf Number	No. of erven	Area	Percentage
Residential 1	1 to 561	561	21.39	26.37
Residential 1 (encroachments)	562 to 596	35	5.84	7.20
General Residential (Res 3)	597 - 598	2	6.64	8.18
Educational	599	1	4.17	5.15
Community Facility - Creche	600 - 601	2	0.28	0.35
Community Facility - Church	604 - 607	4	0.60	0.75
Community Facility - Clinic	606	1	0.18	0.22

Business 1	607	1	0.41	0.5
Public Open Space (attenuation ponds)	608 - 620	9	1.47	1.81
Public Open Space	621 - 635	18	27.32	33.67
Roads			12.81	15.80
Total		635	81.14	100

The development is proposed to encompass –

- Residential 1 erven (including the encroachments areas) that total 596 units located on erven of approximately 300m^2 on average
- Residential 3 erven that total approximately 265 units at a density of 40du/ha
- Various educational, community and business erven that total 9 units
- Public open spaces allocated for storm water management and attenuation
- Public Open Spaces that include open spaces and buffer areas to protect the ecology, cultural heritage features as well as water courses and wetlands
- Roads that provide access and mobility spines

Various infrastructure link services (roads, water, sewage, storm water and electrical supply) will need to be constructed on or across the site.

Potable Water - a bulk water line bisects the site and runs parallel to the existing gravel road. A bulk water connection point will need to be constructed that taps into this line. As an interim measure, 200m stand pipes can be provided in the township. This will be upgraded to household supply when the capacity of the bulk reservoir is upgraded. The upgrade of the existing bulk water reservoir falls outside the scope of this application. The envisaged stand pipes will run adjacent to the internal road network to minimize the magnitude and intensity of water infrastructure crossing sensitive areas. A water use license will be required to address areas where the water pipe will cross watercourses and/or wetlands.

Sewage Disposal and Treatment as there are no planned or proposed bulk sewer facilities or infrastructure. The applicant will be required to provide on site facilities that will include the use of VIP Latrines. These are pit latrine and include a containment pit/tank that is constructed on re-enforced concrete and is provided with a maintenance portal by which sewage can be removed if needed once in 25 years.

Electrical Supply - Currently the area is supplied by Eskom via a 275 KVA bulk line. An 11KVA reticulation system currently services areas directly adjacent to Roosboom and this network can be connect to provide power to each household. The infrastructure will include wooden poles and pole transformers. The network will follow the internal road layout across the site to provide power to the units.

Access and Internal Roads - Main access to the site will continue to be provided via the existing gravel road D637 that connects to the surfaced (tar) Colenso/Ladysmith Road (R103).

The connection of the gravel road to the tar road will require some reconfiguration as the current alignment is not satisfactory. This falls outside the scope of this project and application.

The gravel road will be upgraded to include an intersection that offers the main access to the site.

An internal network of gravel class 4 roads will then offer access to each house following accepted norms and standards. This will include a gravel road and paved sidewalk of 2.0m (on one side of the road). It is recommended that 2.0m wide paved sidewalks be constructed alongside boundaries of schools and commercial/business and retail nodes.

Storm Water Management Plan - the development will require the clearance of indigenous vegetation, the creation of various platforms upon which units will be constructed and the installation of municipal services including piped water, on-site sewage containment, electrification, unsurfaced (gravel) access roads.

Run off from the development areas will be controlled and directed into local storm water berms, culverts, gulleys and attenuation structures to reduce the post development peak flow to acceptable levels. These systems may partially impact on the existing water resources occurring on site.

A storm water plan proposes to construct 9 attenuation ponds located in various catchments of the site. These ponds will temporarily store run off water and allow for the gradual release of the run off via a dropdown box. The outflow from the dam will occur at a headwall that includes anti-erosion measures to prevent the scouring of the natural ground at the outflow. Run off water will then flow naturally as sheet wash into the stream channels and from the site.

The run off water that drains from each house/stand and into the pavement of each road will drain toward an armourflex channel that will carry water to the attenuation ponds. An armourflex channel allows for greater friction to slow the water down whilst also increasing the flow to ground water (permeability of the channel) by infiltration. This is preferred rather than by using solid concrete pipes and channels that increase the speed of run off and allow no infiltration.

Several head walls and outlet structures will need to be built within the 1:100 year flood line and/or buffer to allow for adequate drainage. This impact is relatively small owing to the limited extent of the head wall and anti-erosion structure.

In areas where the run off has already scoured the surface and/or given rise to donga's, a rehabilitation plan (refer to EMPr) must be implemented to stabilize these areas and prevent and/or minimize continued impacts and erosion.

The SWMP will also include structures (such as swales, berms and gabions) within the road way to slow the flow of water and thus reduce its erosion potential. These will be implemented across the site.

The "No Go" Alternative

The No Go Alternative, that includes leaving the land vacant and undeveloped, is an environmentally unsustainable option for the following reasons.

The land lies vacant and within close proximity to the existing township of Roosboom. The land is owned by the Alfred Duma Local Council and therefore the risk of illegal land occupation and the invasion and/or spread of informal settlements is highlight likely. Any illegal land occupation will automatically increase the impact of pollution by uncontrolled sewage flows, grey water impact, alien plant invasion, litter and pollution, frequent fires, dumping of rubble and a host of similar impacts that could lead to the rapid degradation of the ecology and aquatic environment.

Alternatively, the ADLC will need to continually patrol and enforce illegal land occupation or otherwise fence the area and prevent occupation. Both of these actions would be prohibitively expensive and nevertheless require ongoing control and maintenance.

In the short term, the no go option may be viable however the medium to long term options suggest that there is high risk for land invasion that would eventually lead to the degradation of the environment at the site and in the immediate surrounds.

For these reasons the no go option is not considered to be a feasible alternative.

In conclusion

The **preferred (alternative) layout - Figure 6** offers the most feasible sustainable development option for the site.

The layout balances the objectives of the project against the constraints identified on site. The primary constraint includes the occurrence of water courses on site along with the prescribed buffers that have been included in the alternative layout. In addition, the presence of areas of ecological sensitivity along with the occurrence of several highly significant cultural historic features, that include several graves, also had to be included in the alternative layout. The preferred (alternative) layout also makes provision for the 1:100 year floodline to ensure that units will not be flooded.

The site is ideally located adjacent to an existing township. Essential services that include access to water and electricity is available in the area and can be provided to the site. The challenge of sewage disposal services, which is similarly not catered or in the adjacent township, has been engineered to include a modified pit latrine where the waste is conveyed from a formal toilet to a lined pit that is large enough to temporarily store the effluent. A regular maintenance system that includes the use of a Bioenzyme to reduce the sludge volume can offer a sustainable solution for sewage disposal. This is likely to provide the Best Environmentally Practical Solution at this stage. The geohydrological assessment concluded that this system should not adversely impact on the environment and offers a viable strategy for sewage disposal.

The impact assessment as well as findings from the various specialist assessments and investigations suggests that the preferred (alternative) layout will not impact negatively on the environment and/or will not degrade the environment that could not be adequately mitigated by the measures proposed in the EMPr.

On this basis, we recommend that EDTEA approve the **preferred (alternative) layout - Figure 6** to develop a human settlement on Portion 437 and Portion 502 of the Farm Roosboom 1102GS.

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SECTION ONE – BACKGROUND INFORMATION

1.1 Introduction

The Alfred Duma Local Municipality proposes to develop a human settlement in Roosboom, close to the town of Ladysmith in KZN (Contract No. DP and HS 12/2016). The settlement serves to assist in alleviating the tremendous housing shortage within the Municipal Area. These same challenges reflect the priority of housing requirements in large areas across the broader South African landscape.

This project has been awarded to Shatsane Systems Solutions (PTY) LTD T/A SSS Invest.

Eco Assessments CC, as independent environmental assessment practitioners, has been appointed by SSS Investments PTY LTD to compile an application for environmental authorisation to develop a residential township on Portions 437 and Portion 502 of the Farm Roosboom 1102GS (**Figure 1**). The project generally aims to offer 1000 low income top structures along with the relevant services on an area of approximately 85 hectares (**Figure 2**).

This report comprises the Environmental Impact Assessment (EIA) report that seeks to assess the potential impact of the proposed development on the environment. The report synthesizes various specialist assessments, evaluates the issues and concerns raised by Interested & Affected Parties and assesses the significance of the potential impacts on the environment.

In addition, an Environmental Management Plan has been compiled. This plan sets out to minimise potential impacts envisaged to occur on the environment.

1.2 Terms of Reference / Scope of Assessment

The terms of reference for the study included compiling an EIA report for the proposed development activity, as required by the National Environment Management Act (Act No. 107 of 1998) and amended EIA Regulations (2014).

The specific contents of an EIA report, according to the NEMA (2010) Regulations, must include:

- Details of:
  - The EAP who compiled the report;
  - The expertise of the EAP to carry out an environmental impact assessment;
- Detailed Description of the proposed activity;
- A description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is:
  - A linear activity, a description of the route of the activity;
  - An ocean-based activity, the coordinates where the activity is to be undertaken;
- Description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;
- Details of the public participation process conducted in terms of sub regulation (1), including –
  - Steps undertaken in accordance with the plan of study;

    - A list of persons, organisations and organs of state that were registered as interested and affected parties;
    - A summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and
    - Copies of any representations and comments received from registered interested and affected parties;
- A description of the need and desirability of the proposed activity;
- A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives that may have on the environment and the community that may be affected by the activity;
- An indication of the methodology used in determining the significance of potential environmental impacts;
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- A summary of the findings and recommendations of any specialist report or report on a specialised process;
- A description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;
- An assessment of each identified potentially significant impact, including –
    - Cumulative impacts
    - The nature of the impact
    - The extent and duration of the impact;
    - The probability of the impact occurring;
    - The degree to which the impact can be reversed;
    - The degree to which the impact may cause irreplaceable loss of resources; and
    - The degree to which the impact can be mitigated;
- A description of any assumptions, uncertainties and gaps in knowledge;
- A reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;
- An environmental impact statement which contains –
    - A summary of the key findings of the environmental impact assessment; and
    - A comparative assessment of the positive and negative implications of the proposed activity and identified alternatives;
- A draft environmental management plan containing the aspects contemplated in regulation 33;
- Copies of any specialist reports and reports on specialised processes complying with Regulation 32; and
- Any specific information that may be required by the competent authority; and
- Any other matters required in terms of Section 24(4)(a) and (b) of the Act.

1.3 Qualifications of Environmental Assessment Practitioner

Mark Custers (Pri. Sci. Nat.) of Eco Assessments prepared the Environmental Impact Assessment Report for the proposed development.

Mark is a registered environmental scientist with over 20 years' experience in the field of EIA (please refer to CV in **Appendix B**).

SECTION TWO – DETAILED DESCRIPTION OF THE PROJECT

2.1 Applicant Details

The details of the project applicant include the following –

Project applicant	Alfred Duma Local Municipality c/o The Municipal Manager
Contact person	Ms SS Ngiba
Postal Address	PO Box 29 Ladysmith
Postal code	3370
Telephone	036 637 2231
Fax	036 631 1409
E-mail	twngubane@alfredduma.gov.za

The project team that undertook specialist assessments or contributed to the design, detail and application for the proposed township includes the following –

Table 1. Details of the various project team members

Discipline	Company	Responsible Person	Tel	Email
Civil Engineer	Aspire Consulting Engineers	Zeenat Ghoor	082 730 5786	zeenat@aspireconsulting.joburg
Ecologist	Eco Assessments	Christa Custers	082 851 1038	christa@ecoassessments.co.za
Electrical Engineer	Green Vision Consulting Engineers	Allen Manyere	079 721 2472	allen@green-vision.co.za
Geotechnical Engineer	Soil Kraft	Izak Breytenbach	082 577 6215	izak@soilkraft.co.za
GIS Assessment	V-GIS	Koos Viljoen	072 901 5208	koos@v-gis.com
Heritage Consultant	Heritage Consultants	Jaco van der Walt	082 373 8491	jaco@heritageconsultants.co.za
Town Planner	GVS Associates	George Van Schoor	082 554 1860	gvsassoc@mweb.co.za
Traffic Engineer	Chrisen Consulting	Chris Nair	078 800 0369	chris@chrisen.co.za
Wetland Ecologist	Flori Scientific Services	Johannes Maree	082 564 1211	Johannes@flori.co.za
Project Manager	SSS Invest	Silver Shalonga	082 468 0268	silver@sssinvest.co.za
Project Co-Ordinator	Rono Architects	Jerry Munene	071 561 1080	jerry@ronoarchitects.co.za
Architect	Rono Architects	Robert Rono	072 196 9367	Robert@ronoarchitects.co.za
Geohydrologist	Gleamhydro	Johan Kriek	082 339 2543	Johan@gleamhydro.co.za
Water Use License Specialist	Armett Environmental	Dawie Maree	076 950 4679	davie@armett.co.za

2.2 Activities being applied for in terms of NEMA

The following list of activities in terms of the EIA Regulations of 2014 (as amended) is likely to be triggered by the development.:

Table 2. List of activities triggered by the proposed development

GN 327 (07 April 2017)	11	Not Triggered
GN 327 (07 April 2017)	12	The construction activities will include the development of attenuation ponds, weirs, low water bridges, storm water outlet structures and other infrastructure with a footprint greater than 100m^2 within 32m of the water courses. The site lies adjacent to an urban area. This infrastructure will be necessary to manage and control the run off of storm water across the site and protect the site from erosion or localized flooding. The exact points and positions of the SWMP will be provided in the EIA phase of the project.
GN 327 (07 April 2017)	19	The construction activities will include excavation of an accumulated volume of more than 10 cubic meters of soil and sub-soil to form the foundations for the development of attenuation ponds, weirs, low water bridges, storm water outlet structures and other infrastructure with a footprint greater than 100m^2 within 32m of the water courses. The site lies adjacent to an urban area.
GN 327 (07 April 2017)	24	The proposed township includes the construction of several internal and link gravel roads to provide access to the units. The internal roads will also need to link to the existing gravel roads that bisect the residential areas of Roosboom that lies adjacent to the site.
GN 327 (07 April 2017)	25	Not Triggered
GN 327 (07 April 2017)	28	The development will create a residential township larger than 1 hectare in extent on land that has not formally been used for agriculture since 01 April 1998 and that lies adjacent to an urban area. The site however has not been previously developed.
GN 325 (07 April 2017)	15	The construction activities and establishment of the township will clear an area greater than 20 hectares of indigenous vegetation.

In addition, either a General Authorisation and/or Water Use License Application will need to be compiled in accordance with requirements of the National Water Act and/or relevant regulations pertaining to water use (i.e. Regulation 509 of 2016). This is because the development will include crossing the non-perennial watercourse in addition to development within 500m of a wetland. The development also included the development of lined VIP Latrines that will store domestic sewage effluent.

Similarly and only where relevant, a Phase 2 cultural historic assessment report and application will be required where cultural historic features may be directly impacted upon. This will include a destruction permit application. Currently the layout aims to protect all very high and high significant cultural historic features *in situ.*

2.3 Considered Legislation and Guidelines

The proposed development will trigger a number of legal requirements that must first be fulfilled prior to commencement of the project. These include several national, provincial and local obligations that have been established to promote and support sustainable development and/or the protection of the environment.

The discussion below presents only but a concise summary of the key relevant obligations as they relate to this project. For further detail, the relevant Act should be consulted.

2.3.1 National Environmental Management Act (NEMA)

The National Environmental Management Act (107 of 1998) provides for co-operative environmental governance by establishing principles for decision making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state.

One of the key objectives of NEMA is to promote the integration of social, economic and environmental factors in the planning, implementation and evaluation of decisions to ensure that development serves present and future generations i.e. it is a sustainable development. This is in support of the Constitutional Right where everyone has the right to an environment that is not harmful to his or her health or well-being.

Furthermore, the State must respect, protect, promote and fulfil the social, economic and environmental rights of everyone and strive to meet the basic needs of previously disadvantaged communities.

In terms of the above, the NEMA requires that certain development activities, that could potentially affect or impact in the environment, first be considered and approved prior to commencing with the activity. These activities are listed under the NEMA EIA 2014 Regulations (as amended, April 2017) Listing Notices 1, 2 and 3.

The proposed development is likely to trigger several of these listed activities and will therefore require environmental authorisation, either as part of a Basic Assessment report process or Scoping and Environmental Impact Assessment report process. Each process is prescribed to follow a specific pattern and time frame in order to provide the Competent Authority with relevant and applicable information to use in making an informed decision. A key part of this process and the information that must be provided includes relevant comment from registered Interested and/or Affected Parties, including the public.

2.3.2 National Environmental Management: Biodiversity Act

The NEM:BA (Act No. 10 of 2004) provides for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act, 1998; the protection of species and ecosystems that warrant protection; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.

Provided for under the National Environmental Management: Biodiversity Act (No. 10 of 2004), bioregional plans inform land-use planning, environmental authorisations and natural resource management outside of protected areas. The development of

bioregional plans for municipalities is a National Biodiversity Framework priority. The bioregional plan serves as the primary source of biodiversity information for a range of planning processes. Bioregional plans map the Critical Biodiversity Areas (CBAs) in a municipality for use in municipal level planning such as the Integrated Development Plan (IDP) and Spatial Development Framework (SDF). The CBAs identified in bioregional plans also trigger Listing Notice 3 of the Environmental Impact Assessment (EIA) regulations (Chapter B2). In cases where a bioregional plan has not yet been published, the relevant provincial spatial biodiversity plan should be used.

Important sections of the Biodiversity Act includes:

S56. Listing of species that are threatened or in need of national protection

S57. Restricted activities involving listed threatened or protected species and species to which an international agreement regulating international trade applies

S65. Restricted activities involving alien species

S67. Restricted activities involving certain alien species totally prohibited

S69(1). Duty of care relating to alien species

S75(1)-(3). Control and eradication of listed invasive species

- Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.

- Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.

- The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and regrowth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

The Conservation of Agricultural Resources Act 43 of 1983 and associated regulations further regulates weeds and invader plants; which includes:

Regulation 15 of Regulations (GNR 1048 of 25 May 1984)

S15 E Where category 1, 2 or 3 plants occur contrary to the provision of these regulations, a land user shall control such plants by means of one or more of the following methods of control as is appropriate for the species concerned and the ecosystem in which it occurs:

(a) uprooting, felling, cutting or burning;
(b) treatment with a weed killer that is registered for use in connection with such plants in accordance with the directions for the use of such a weed killer;
(c) biological control carried out in accordance with the stipulations of the Agricultural Pests Act, 1983 (Act No. 38 of 1983), the Environment Conservation Act, 1989 (Act 73 of 1989) and any other applicable legislation;

(d) any other method of treatment recognised by the executive officer that has as its object the control of the plants concerned, subject to the provisions of subregulation (4);
(e) a combination of one or more of the methods prescribed in paragraphs (a), (b), (c), and (d), save that biological control reserves and areas where biological control agents are effective shall not be disturbed by other control methods to the extent that the agents are destroyed or become ineffective.

The site earmarked for the development has historically been used for agricultural activities that include a farm house as well as old cultivated fields. Parts of the site remain untransformed. The site does fall within a Critical Biodiversity Area (CBA).

Several alien exotic plants occur on the the site and these will need to be removed and/or managed in a way that is consistent with the NEM:BA as well as CARA (see below). Should species of conservation importance and/or species that require protection in terms of the NEM:BA occur on site, then the relevant protocols as prescribed in the Act will need to be implemented. This will be verified and confirmed by relevant specialist assessments.

2.3.3 National Environmental Management: Waste Act

The National Environmental Management: Waste Act (Act 59 of 2008) aims to reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.

The NEM: Waste Regulations (GNR 718 July 2009) prescribe application requirements in terms of the nature and extent of various waste streams. These include a listing of relevant waste management activities that have, or are likely to have a detrimental impact on the environment. This includes various categories of General Waste and/or Hazardous Waste.

Activities that fall within Category A are required to follow a NEMA: Basic Assessment process, whereas activities that fall within Category B trigger the requirement for a Scoping and EIA application.

Both applications then include an application for a Waste Management License.

The proposed development is not anticipated at this stage to trigger any of the listed waste management activities as domestic refuse generated by each household will either integrated into the local municipal waste collection system and/or localized waste collection areas will be created where appointed waste collection contractors will then collect the refuse. Only limited and localised areas are likely to be established within the layout to cater for the need and opportunity for waste recycling initiatives. The volume of waste likely to be temporarily stored each month is likely to be low. It is not foreseen at this stage that a waste water treatment works will be developed as part of the application.

2.3.4 National Water Act (NWA)

The National Water Act (36 of 1998) recognizes that water is a scarce and unevenly distributed national resource which occurs in many different forms which are all part of a unitary, inter-dependent cycle, that belongs to all people and where the discriminatory laws and practices of the past have prevented equal access to water, and use of water resources, and that the protection of the quality of water resources

is necessary to ensure sustainability of the nation's water resources in the interests of all water users.

Section 21 of the NWA thus regulates the use of water so that a water use license or general authorization is required where water is used.

Water use is defined to include –
- Taking water from a water resource;
- Storing water;
- Impeding or diverting the flow of water;
- Engaging in a stream flow reduction activity;
- Engaging in a controlled activity;
- Discharging waste or water containing waste into a water resource;
- Disposing of waste;
- Disposing in any manner of water which contains waste from any industrial or power generation process;
- Altering the bed, banks, course or characteristics of a watercourse;
- Removing, discharging or disposing of water found underground;
- Using water for recreational purposes.

The proposed development is likely to trigger the need for a water use license, or general authorisation, as a water course bisects the site.
In addition, Regulation 509 of the NWA requires that a water use license or general authorisation may be required where development occurs within 500m of a wetland or pan.

The settlement is further likely to impact on water resources by means of storm water run off, the construction of bulk or link services, roads, pedestrian crossings and similar activities that will comprise the layout plan.

2.3.5 National Heritage Resources Act (NHRA)

A Heritage Impact Assessment, as a specialist sub-section of the EIA, is required under the National Heritage Resources Act NHRA of 1999 (Act 25 of 1999), Section 23(2) (b) of the NEMA and section S. 39 (3) (b) (iii) of the MPRDA.

The aim of the study is to identify cultural heritage sites, document, and assess their importance within local, provincial and national context. It serves to assess the impact of the proposed project on non-renewable heritage resources, and to submit appropriate recommendations with regard to the responsible cultural resources management measures that might be required to assist the developer in managing the discovered heritage resources in a responsible manner. It is also conducted to protect, preserve, and develop such resources within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999).

A Phase 1 of an AIA or a HIA is a pre-requisite for development in South Africa as prescribed by SAHRA and stipulated by legislation. The overall purpose of a heritage specialist input is to:

- Identify any heritage resources, which may be affected;
- Assess the nature and degree of significance of such resources;
- Establish heritage informants/constraints to guide the development process through establishing thresholds of impact significance;

- Assess the negative and positive impact of the development on these resources;
- Make recommendations for the appropriate heritage management of these impacts.

The AIA should be submitted, as part of the EIA, BIA or EMP, to the PHRA if established in the province or to SAHRA. SAHRA will be ultimately responsible for the professional evaluation of Phase 1 AIA reports upon which review comments will be issued. 'Best practice' requires Phase 1 AIA reports and additional development information, as per the EIA, BIA/EMP, to be submitted in duplicate to SAHRA after completion of the study. SAHRA accepts Phase 1 AIA reports authored by professional archaeologists, accredited with ASAPA or with a proven ability to do archaeological work.

Phase 1 AIA's are primarily concerned with the location and identification of sites situated within a proposed development area. Identified sites should be assessed according to their significance. Relevant conservation or Phase 2 mitigation recommendations should be made. Recommendations are subject to evaluation by SAHRA.

Conservation or Phase 2 mitigation recommendations, as approved by SAHRA, are to be used as guidelines in the developer's decision making process.

Phase 2 archaeological projects are primarily based on salvage/mitigation excavations preceding development destruction or impact on a site. Phase 2 excavations can only be conducted with a permit, issued by SAHRA to the appointed archaeologist. Permit conditions are prescribed by SAHRA and includes (as minimum requirements) reporting back strategies to SAHRA and deposition of excavated material at an accredited repository.

In the event of a site conservation option being preferred by the developer, a site management plan, prepared by a professional archaeologist and approved by SAHRA, will suffice as minimum requirement.

After mitigation of a site, a destruction permit must be applied for from SAHRA by the client before development may proceed.

Human remains older than 60 years are protected by the National Heritage Resources Act, with reference to Section 36. Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act), as well as the Human Tissues Act (Act 65 of 1983), and are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36[5]) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in this age category, located inside a formal cemetery administrated by a local authority, require the same authorisation as set out for graves younger than 60 years, in addition to SAHRA authorisation. If the grave is not situated inside a formal cemetery, but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws, set by the cemetery authority, must be adhered to.

Human remains that are less than 60 years old are protected under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925), as well as the Human Tissues Act (Act 65 of 1983), and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the office of the relevant Provincial Premier.

This function is usually delegated to the Provincial MEC for Local Government and Planning; or in some cases, the MEC for Housing and Welfare. Authorisation for exhumation and re-internment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. To handle and transport human remains, the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

2.3.6 Conservation of Agricultural Resources Act (CARA)

The Conservation of Agricultural Resources Act (43 of 1983) provides for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.
The objects of this Act are to provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants.

2.3.7 Municipal By Laws

2.3.7.1 Nuisance and Behaviour in Public Places (23 Nov 2016)

To provide for measures for preventing, minimising or managing public nuisances; to prohibit certain activities or conduct in public places; to provide for the repeal of laws and savings; and to provide for matters incidental thereto. The objects of this By-law are to provide-

(a) measures to regulate and control conduct or behaviour which causes or is likely to cause discomfort, annoyance or inconvenience to the public or users of any public place, so as ensure that any such discomfort, annoyance or inconvenience is avoided, and where total avoidance is impossible or impractical, is minimised and managed;
(b) certain conduct or behaviour within a public place in order to prevent nuisances; and
(c) penalties for breach of its provisions.

2.3.8 Policies, Plans & Programmes

Central to relevant policies, plans and programmes is the earmarked Integrated Development Plan for the Emnambithi Local Municipality (refer to the Town Planning Prefeasibility Report for relevant details).

2.3.9 Guidelines

The KZN Wildlife has published a handbook for specialist studies that accompany any Environmental Impact Assessment. This handbook provides recommendations and approaches that should be used when investigating an area that comprises part of an EIA application. The handbook further makes reference to various particular fields of investigation and offers guidance on the assessment criteria and mapping tools that should be used to inform the EIA report and application.

Of particular reference to the study site is the need for aquatic, wetland, water course and natural vegetation assessments owing to the presence of these features on the site and on adjoining areas.

2.4 Description of the Property Including Location

The Alfred Duma Local Municipality (previously the Emnambithi/Ladysmith Municipality) is located within the Province of KwaZulu-Natal and within the uThukela District Municipality (DC23). The site lies on the western extent of the Municipal Area and approximately 12km south west of the town Ladysmith.

Access to the site is available via the R103/N11 (Ladysmith/Colenso Road) approximately 6.5km south of the R616/N11 Road to the N3.

Various local access points off existing gravel roads occur to the north and the south of the site.

2.5 Description of the Proposed Activity [Proposal]

The project entails the establishment of a human settlement / residential township on the site.

A preliminary layout indicates the following key land uses and development activities (**Figure 3**).

Table 3. Details for the Proposed township layout

Landuse	Erf Number	No. of erven	Area	Percentage
Residential 1	1 - 1112	1112	42.9813	52.97
Community Facility - Creche	1113 - 1114	2	0.2929	0.36
Community Facility - Church	1115 - 1118	4	0.4807	0.59
Business 1	1119	1	0.3044	0.38
Public Open Space	1120 - 1129	10	18.6206	22.95
Roads			18.4615	22.75
Total		1129	81.1415	100

The development is proposed to encompass –

- Approximately 1000 Residential 1 stands (ranging from 200m^2 to 400m^2 in extent),
- Erven for Business 1 land use, Community Facilities that include churches, crèches and Educational uses;
- Public Open Space and
- Roads.

Various infrastructure link services (roads, water, sewage, storm water and electrical supply) will need to be constructed on or across the site.

The development will require the clearance of indigenous vegetation, the creation of various platforms upon which units will be constructed and the installation of

municipal services including piped water, on-site sewage containment, electrification, unsurfaced (gravel) access roads.

Run off from the development areas will be controlled and directed into local storm water berms, culverts, gulleys and attenuation structures to reduce the post development peak flow to acceptable levels. These systems may partially impact on the existing water resources occurring on site.

2.6 Existing & Proposed Engineering Services

Various professional engineers have compiled outline scheme reports that describe the current and proposed level of service delivery to the site.

These reports focus primarily on the provision of bulk services and not the internal services. It is important to note that relevant services will link into existing services already existing or planned to occur as the site is located within an area earmarked for residential development and that lies adjacent to area under development.

Below is a summary of the relevant points that apply to each service (for a more detailed description of the relevant service please refer to the appropriate specialist engineering report in the relevant appendix). See **Figure 4** for the existing and proposed services that will be used to service the site.

2.6.1 Water (refer Appendix D1)

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 **Figure 4**), with a dedicated 110 mm diameter connection currently supplying nearby facilities.

The uThukela District Municipality has confirmed that Bulk Water infrastructure is available via the Platrand 865 000KL line and that 200m stand pipes can be provided to provide water to the site (as opposed to each house receiving its own connection) - refer to **Appendix D2**. Currently no detailed plan or survey exists to provide this infrastructure. A future bulk water connection to service the development will be required at a budgeted cost of R10 million.

The existing reservoir is unable to meet the requirement of the additional demand. The infrastructure is aged and tanks comprise corrugated steel. The capacity needs to be upgraded and an initial budgeted amount of R4 million is required. Currently there is no time frame associated within this upgrade.

Even though there is an existing dedicated water reticulation pipe that could be used to potentially service the proposed development, during periods of severe drought , the above-mentioned existing water line could go out of supply for a couple of months or sometimes , on occasions for even longer periods.

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

Average Daily Water Demand

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

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)

It is recommended that the project be implemented using standpipes placed at approximately 200 metres of each household noting that the project is rural in nature. No further bulk infrastructure is required. The Uthukela District Municipality has confirmed that the use of the 200m stand pipes will be acceptable (Refer to **Appendix D2 and D3**).

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.

2.6.2 Sewerage (refer Appendix D)

The Alfred Duma Local Municipality confirmed that currently there is no bulk infrastructure linking the proposed development site to an appropriate municipal sewage connection.

The uThukela District Municipality has confirmed that no bulk sewer infrastructure is available on site, no bulk sewer plant can services the site and no plans exist to provide an existing sewer connection (**Appendix D2**). Currently there is no plan to provide a bulk sewer to the Roosboom area. However the need to such planning and the need for a New Plant is acknowledged.

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)

The Ventilated Improved Pit (VIP) latrine system (refer to **Appendix M2**) 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 may be lined which is recommended where emptying is of the pit is required, or unlined where soil conditions allow. It also can be

constructed as a double pit system 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.

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 might be essential in order to provide structural stability to the latrines
- Alternating twin pit VIP latrines should be used where appropriate and cost – effective.

2.6.3 Storm Water (refer Appendix E & Figure 5)

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. However there is an existing donga on the lower southern end of the site. The proposed storm water drainage for the development would discharge to this donga.

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 narrow steep-sided ravine which was formed by water erosion which is usually dry except in the rainy season (i.e donga) on the lower southern side of the site.

2.6.4 Access/Traffic (refer Appendix F)

The following roads with brief descriptions play significant roles within the study area:

Route R103: This road is a Class 2 rural road having one lane in each direction and runs in a north-south alignment east of the proposed development site. The R103 intersects with N11 to the north of the site. Route R103 intersects with D637 and will provide access to the proposed development. The posted speed limit on R103 is 80 km/h.

D637: This road is a Class 4 Gravel rural collector road and runs in a south east-north west alignment. Route D637 will provide access to the proposed development on Portion 437 of the Farm Roosboom, no 1102 -G.S.

The proposed development will comprise of a network of internal Class 4 and Class 5 roads. Access to the proposed development will be provided via the intersection of R103 and D637.

The intersection of R103 and D637 currently requires a reconfiguration, in order to accommodate the proposed township development, the following is required:

- Reconfiguration of R103 and D637 intersection:
- The intersection currently comprises of a skewed T – Junction with priority at R103 and requires upgrades. It should be noted that the intersection layout is an existing problem and the proposed township development does not negatively impact the existing road network layout.

It is proposed that the existing intersection of R103 and D637 be reconfigured as follows:

- The R103 and D637 intersection should comprise of a 90 degrees T-Junction Dedicated right-turn lane (60,0 m) on the southbound direction
- Dedicated left-turn lane (60,0 m) on the northbound direction
- Dedicated right-turn lane (60,0 m) on the eastbound direction
- Single lane in each direction for all the legs of the intersection
- Proposed access intersection to the township development on Portion 437 of the Farm Roosboom No 1102- G.S:

The proposed township development will comprise of an intersection that will connect with the existing gravel Road and will be provided as follows:

- Dedicated right-turn lane (30,0 m) on the northbound direction
- A shared through and left turn lane on the northbound direction
- A receiving lane on the northbound direction

- Dedicated right-turn lane (30,0 m) on the eastbound direction
- A shared through and left turn lane on the eastbound direction

- Dedicated right-turn lane (30,0 m) on the southbound direction
- A shared through and left turn lane on the southbound direction
- A receiving lane on the southbound direction

- Dedicated right-turn lane (30,0 m) on the westbound direction
- A shared through and left turn lane on the westbound direction

The master plan provides a framework and ensures that the proposed development is sustainable from a traffic engineering point of view. The proposed development will have one access off the external road network (Gravel Road), refer to Section 4.4. In terms of accesses to various sites, it is proposed that each site will gain access from new internal Class 4 and Class 5 roads.

The proposed development is expected to generate 512 and 507 trips during the AM and PM peak hour respectively. This development generated trips were calculated by taking into account trip adjustment factors for mixed use developments, low vehicle ownership and transit node or corridors.

Various trip adjustment factors have been introduced.

- **Mixed Use Developments (MUD)**: According to the COTO manual "mixed use developments are defined as developments in an area that consist of two or more single use developments between which trips can be made by means of non-motorised modes of transport (such as walking). This has the net effect of reducing the vehicle trip generation in the area."

- Since this development will consist of a mixed-use development, the reduction factors recommended in the manual were applied

- **Low Vehicle Ownership (LVO) & Very Low Vehicle Ownership (VLVO)**: According to the COTO manual "the vehicle ownership in areas with high levels of vehicle ownership varies between one or two per household. In areas with a low level of vehicle ownership, the majority of households (more than 50%) does not own a vehicle and relies on public transport for transportation. In areas with very low level of vehicle ownership, nearly all households (more than 90%) do not own a vehicle and rely on public transportation."

This study considered very low vehicle ownership.

Transit Nodes or Corridors: According to the COTO manual "the transit reduction factors are applicable to developments that are located within a reasonable walking distance from a major transit node or stops on a major transit corridor."

Public Transport
The area surrounding the proposed development site is currently served by the following public transport services:

Minibus taxis and buses were observed operating along the surrounding road network.

The following results were obtained from the minibus taxi and buses average link volume analysis for both the southbound and northbound approach along R103 during the 12-hour period:

- Minibus Taxis = 337
- Buses = 22

There is an existing bus / taxi layby at the intersection of R103 and D637.

The following is proposed to cater for public transport to/from the development:

Public Transport Lay-bys: It is recommended that the main Class 4 link road within the proposed development have public transport lay-bys in the form of bus / taxi stops at appropriate locations within a maximum walking distance limited to 450,0 m.

Minibus Taxi Rank / Holding Facility: It is recommended that a common minibus taxi rank be provided which will serve the proposed township development.

Paved Sidewalks: In order to ease and formalise the movement of pedestrians between the site accesses and the recommended lay-bys, it is proposed that 2,0 m wide paved (or dust free) sidewalks be constructed along at least one side of all Class 4 roads within the proposed development. It is also recommended that 2,0 m wide paved (or dust free) sidewalks be constructed along site boundaries of schools and commercial / business and retail nodes.

Raised Pedestrian Crossings: To improve pedestrian safety, it is proposed that safe pedestrian crossings be implemented at suitable positions on the internal Class 4 roads near schools, commercial / business and retail nodes. This will be addressed in separate traffic impact studies.

With the above recommendations adhered to, the proposed developments are supported in terms of non-motorised and public transport viewpoint.

2.6.5 Electricity (refer Appendix G)

A professional electrical engineer undertook an outline scheme report investigation to ascertain the existing capacity and supply options to service the development.

Load Requirements
The following Eskom Low Voltage design parameters are set as the bench mark for low cost Housing and will be used to calculate the estimated bulk load for the development:

Low Voltage Parameters (Final Design)

ADMD	2.4KVA/stand.
Supply voltage	415/240V
Regulation	+ 10% / - 8%
Service connection	20A max

Estimated Total Load = 2.7MVA
NB: ADMD=After Diversity Maximum Demand

Bulk Power Supply
Within the vicinity of Roosboom Development there is an existing Eskom High Voltage (HV - 275kV and 400kV) and a Medium Voltage (11Kv) network which is running next to the proposed site boundary. This can be used to supply power to the site.

Electrical Bulk Supply Option
Eskom Network Planning department has approved 557 connections so far with an ADMD of 1kVA/stand. The take-off feeder will be **Twin Hills NB106** and with pole number **COR 237**.This capacity will be split according to Eskom standard 16kVA, 50kVA, 64kVA, 100kVA and 200kVA pole mounted transformers to make up the 2.4MVA.

Existing Medium Voltage (MV) Network
There is an Existing Eskom MV network close or adjacent to the development which is planned to be used for supplying the development. The proposed Take/Off Pole is **COR 237** as confirmed by Eskom.

Eskom Network planning department was engaged to provide a Network Planning Report and they confirmed availability of capacity in addition to providing the necessary recommendations that fall within their Network Master Plan through the municipality.

Medium Voltage Reticulation
The external and internal MV reticulation will be done according to Eskom standards and taken over by Eskom for maintenance and customer servicing.

Conductor types will include Mink, Hare and Fox.

Medium Voltage supply consists of three phase conductor as a backbone. The conductor shall be mounted on 11m & 12m wood poles and shall run street-front. Pole mounted transformers of the type 11kV/420V SABS 780 shall be mounted on 11m & 9m poles.

Low Voltage Reticulation
The low voltage feeders shall be three phase 4 core aerial bundle conductor with bare neutral and shall be 70mm² and 35mm². The LV network is to be constructed on street-front layout on 7m wooden poles. The feeders shall be fused at the transformer pole.

All LV structures shall be constructed in accordance with Eskom Low Voltage Distribution Standard and specifications (refer to **Appendix G** for relevant details of each design).

2.6.7 Waste Management

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.

2.7 A description of alternatives

2.7.1 Alternative 1 (Preferred Alternative Layout)

Figure 6 illustrates the alternative position and extent of the **preferred alternative layout**. This differs quite significantly to the proposed layout (as indicated in the Final Scoping Report) as the preferred layout eliminates direct impacts on several sensitive areas and seeks to ensure that the development is more sustainable (Refer to the Combined Sensitivity Map **Figure 17).**

The development entails the establishment of a human settlement / residential township on the site.

A preferred layout indicates the following key land uses and development activities (**Figure 6**).

Table 4. Details of the Preferred alternative layout

Landuse	Erf Number	No. of erven	Area	Percentage
Residential 1	1 to 561	561	21.17	26.10
Residential 1 (encroachments)	562 to 596	35	5.84	7.20
General Residential (Res 3)	597 - 598	2	6.64	8.18
Educational	599	1	4.17	5.15
Community Facility - Creche	600 - 601	2	0.28	0.35
Community Facility - Church	602 - 605	4	0.60	0.75
Community Facility - Clinic	606	1	0.18	0.22
Business 1	607	1	0.41	0.5
Public Open Space (attenuation ponds)	608 - 620	9	1.47	1.81
Public Open Space	621 - 635	18	27.32	33.67
Roads			12.81	15.80
Total		634	81.14	100

The development is proposed to encompass –

- Residential 1 units located on an erf size of approximately 300m^2 (this follows standard policy requirements as set by the Alfred Duma Local Municipality - Page 20 of **Appendix C**).

- Residential 1 erven (including the encroachments areas) that total 596 units. These will include single storey units of 40 - 50m^2 each some of which will be semi-detached.

Typical illustration of the proposed residential unit

- Residential 3 erven that total approximately 265 units at a density of 40du/ha. These will include double storey units.

Typical illustration of a multi storey residential unit

- Various educational, community and business erven that total 9 units

Typical illustration of a community centre, crèche or clinic

- Public open spaces allocated for storm water management and attenuation (refer to **Appendix E** for the typical illustrations of the proposed infrastructure)
- Public Open Spaces that include open spaces and buffer areas to protect the ecology, cultural heritage features as well as water courses and wetlands
- Roads that provide access and mobility spines

Various infrastructure link services (roads, water, sewage, storm water and electrical supply) will need to be constructed on or across the site.

Potable Water - a bulk water line bisects the site and runs parallel to the existing gravel road. A bulk water connection point will need to be constructed that taps into this line. As an interim measure, 200m stand pipes can be provided in the township. This will be upgraded to household supply when the capacity of the bulk reservoir is upgraded. The upgrade of the existing bulk water reservoir falls outside the scope of this application. The envisaged stand pipes will run adjacent to the internal road network to minimize the magnitude and intensity of water infrastructure crossing sensitive areas. A water use license will be required to address areas where the water pipe will cross watercourses and/or wetlands.

Sewage Disposal and Treatment - as there is no planned or proposed bulk sewer facilities or infrastructure, the applicant will be required to provide on site facilities that will include the use of VIP Latrines.

The substructure or pit of the **Ventilation Improved Pit (VIP) Toilet** to be implanted on this site will be rectangular even though in some instances circular pits have been commonly used in recent times.

The walls of the pit will be lined with 300mm thick reinforced concrete walls. The pit will operate as a dry pit and all the sludge will be retained in the pit. Decomposition will be aided by adding Sannitree **Double Action Bio-Enzyme Granules** which are a blend of freeze-dried bacteria and enzymes specially formulated to rapidly digest organic waste, reduce bad odours and the fly population found in and around pit latrines.

A minimum space of width of 1.20m and length of 1.20m should be provided for every squatting space.

A bin for hygienic disposal of sanitary materials must be provided in every chamber in the latrine.

The substructure should not be closer than 2.75m from the boundaries of the plot. Access must be provided for maintenance/emptying crews.

The pit should be 30m away and downhill from any borehole or well. It should be on slightly raised ground with firm soil. It should be conveniently located near the house and away from trees.

Generally, the pit volume depends on the solids accumulation rate, the number of users, and the desired life of the pit. A free space at the top of the pit, usually 0.5m must be allowed for in the design. The pit should have sufficient volume/capacity to be in use for at least 10-20 years of continuous use without emptying. In dry pits the solids accumulation rate varies between 0.03 and 0.05m^3 per person per year. The use of Sannitree **Double Action Bio-Enzyme Granules** will reduce the typical solid accumulation rate to within a range of approximately 0.02 and 0.04m^3 per person per year.

Design check for Anticipated Sludge accumulation
For the proposed system with 1 household being serviced by one pit. 1 rural residential unit is expected to generate an average sludge of;

(0.04m^3/ca/yr) x 10.0 ca/unit x 1unit = 0.4m^3/year

Adopting a **3.5m** wide x **4.0m** long x **1.5m** deep tank to service a single Households will provide **16.1m^3** *(see containment pit configuration on Drawing No: S-C-VIPLLL-01RevA)* capacity which is adequate to contain the sludge generated in a single house hold for a period of 20 years without emptying the pit.

The bio-enzyme has a double-action formula which is specially formulated to rapidly digest organic waste. It also contains an active ingredient which attacks the larvae of flies, preventing them from shedding their skins. As this is an essential part of the larvae's growth and development, this double action product effectively stops the larvae from turning into flies.

We recommend that the bio-enzyme granules (100g sachets) be added once annually. A 100g sachet can be utilized on two pits 16m^3 pits. Each 100g sachet costs approximately R50.00

Benefits of using Bio-Enzyme Granules

- Rapidly digests organic waste assuring easy pump-outs
- Attacks and neutralises fly larvae
- Reduces bad smells
- Non-hazardous to people, animals and water bodies
- Can be beneficial when discharged after pumping to sewage treatment works

Detail of the proposed sewage treatment system proposed for the site (Refer to **Appendix M2 & Figure 7**):

Electrical Supply - Currently the area is supplied by Eskom via a 275 KVA bulk line. An 11KVA reticulation system currently services areas directly adjacent to Roosboom and this network can be connect to provide power to each household. The infrastructure will include wooden poles and pole transformers. The network will follow the internal road layout across the site to provide power to the units.

Access and Internal Roads - Main access to the site will continue to be provided via the existing gravel road D637 that connects to the surfaced (tar) Colenso/Ladysmith Road (R103).

The connection of the gravel road to the tar road will require some reconfiguration as the current alignment is not satisfactory. This falls outside the scope of this project and application.

The gravel road will be upgraded to include an intersection that offers the main access to the site.

An internal network of gravel class 4 roads will then offer access to each house following accepted norms and standards. This will include a gravel road and paved sidewalk of 2.0m (on one side of the road). It is recommended that 2.0m wide paved sidewalks be constructed alongside boundaries of schools and commercial/business and retail nodes.

Storm Water Management Plan - the development will require the clearance of indigenous vegetation, the creation of various platforms upon which units will be constructed and the installation of municipal services including piped water, on-site sewage containment, electrification, unsurfaced (gravel) access roads.

Run off from the development areas will be controlled and directed into local storm water berms, culverts, gulleys and attenuation structures to reduce the post development peak flow to acceptable levels. These systems may partially impact on the existing water resources occurring on site.

A storm water plan (**Refer to Figure 5**) proposes to construct 9 attenuation ponds located in various catchments of the site. These ponds will temporarily store run off water and allow for the gradual release of the run off via a dropdown box. The outflow from the dam will occur at a headwall that includes anti-erosion measures to prevent the scouring of the natural ground at the outflow. Run off water will then flow naturally as sheet wash into the stream channels and from the site.

The run off water that drains from each house/stand and into the pavement of each road will drain toward an armourflex channel that will carry water to the attenuation ponds. An armourflex channel allows for greater friction to slow the water down whilst also increasing the flow to ground water (permeability of the channel) by infiltration. This is preferred rather than by using solid concrete pipes and channels that increase the speed of run off and allow no infiltration.

Several head walls and outlet structures will need to be built within the 1:100 year flood line and/or buffer to allow for adequate drainage. This impact is relatively small owing to the limited extent of the head wall and anti-erosion structure.

In areas where the run off has already scoured the surface and/or given rise to donga's, a rehabilitation plan (refer to EMPr) must be implemented to stabilize these areas and prevent and/or minimize continued impacts and erosion.

The SWMP will also include structures (such as swales, berms and gabions) within the road way to slow the flow of water and thus reduce its erosion potential. These will be implemented across the site.

2.7.2 Alternative 2 (Sewer Options)

Various sewer options were considered in the impact assessment phase of the project, as required by the EDTEA in the approved scoping report (**Appendix A1**).

The preferred option, following and evaluation of engineering costs:benefit indicated that the pit laterine (a modification of the Ventilated Improved Pit Laterine) offers the Best Practicable Environmental Option for providing sewage services to the site (see below for a detailed description and **Appendix M1 & M2**).

Options that were considered also included the following -

Install Ventilated Improved 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 may be lined which is recommended where emptying is of the pit is required, or unlined where soil conditions allow. It also can be constructed as a double pit system 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.

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 m2 at the lower end of the proposed site.

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.

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.

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 greywater 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.

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.

Pour-flush latrine with containment pit

This type of latrine is recommended where there is adequate water in the community for flushing and where there is a Masterplan in place to incorporate a water-borne sewerage system to service the proposed development as this could easily be converted into a water-borne sewerage system.

A Pour-flush latrine with a containment pit is installed with a pan with a water seal (a U-shaped conduit partly filled with water) in the defecation hole. This overcomes the problems of flies, mosquitoes and odour. After use, the latrine is flushed by pouring water into the pan. The concrete floor slab with the pan is either on top of the containment pit (direct system) or a short distance away (offset system).

Pits are lined with concrete to retain the waste as well as to provide the required structural integrity to retain the required depth of earth material surrounding the containment pits.

The containment pit will be emptied by honey sucker trucks at regular intervals to prevent spillage, overflowing and unhygienic conditions.

2.7.3 The “No Go” Alternative

The No Go Alternative, that includes leaving the land vacant and undeveloped, is an environmentally unsustainable option for the following reasons.

The land lies vacant and within close proximity to the existing township of Roosboom. The land is owned by the Alfred Duma Local Council and therefore the risk of illegal land occupation and the invasion and/or spread of informal settlements is highlight likely. Any illegal land occupation will automatically increase the impact of pollution by uncontrolled sewage flows, grey water impact, alien plant invasion, litter and pollution, frequent fires, dumping of rubble and a host of similar impacts that could lead to the rapid degradation of the ecology and aquatic environment.

Alternatively, the ADLC will need to continually patrol and enforce illegal land occupation or otherwise fence the area and prevent occupation. Both of these actions would be prohibitively expensive and nevertheless require ongoing control and maintenance.

In the short term, the no go option may be viable however the medium to long term options suggest that there is high risk for land invasion that would eventually lead to the degradation of the environment at the site and in the immediate surrounds.

For these reasons the no go option is not considered to be a feasible alternative.

2.8 Strategic Planning for the area and surrounding area

2.8.1 Policy Framework

The introduction of the **Housing Act, (Act No 107 of 1997)**, has seen National Government introduce a comprehensive programme to address a range of housing needs in South Africa. The programme is outlined in the National Housing Code and the Comprehensive Plan for the Creation of Sustainable Human Settlements (commonly known as Breaking New Ground).

The **Breaking New Ground Policy (BNG)** provides a framework for the development of human settlements in the South African context. It aims to facilitate a shift from merely providing housing to ensuring the creation of sustainable human settlements. It also grants municipalities a greater responsibility in the housing delivery process. BNG includes a number of programmes that are intended to facilitate the successful implementation of the human settlements development agenda. The Roosboom Housing Project is one such business plan

The National Government embarked on a process to determine outcomes that must be achieved in 2012. From this process 12 outcomes were identified, which were set to be the key focus of government. The issue of sustainable human settlement linked with quality of household life was identified as outcome 8.

This outcome contains four (4) outputs and targets as follows:

- Output 1: Accelerated Delivery of Housing Opportunities.
- Output 2: Access to basic services.
- Output 3: Mobilization of well-located public land for low income and affordable housing with increased densities on this land and in general.
- Output 4: Improved Property Market.

The proposed Roosboom Housing Project represents a stride towards the fulfilment of Outcome 8.

The **KZN Provincial Master Spatial Plan** aims to translate the Provincial Growth and Development Plan (PGDP) into a detailed implementation plan for assisting with the identification of sustainable land for housing delivery in the province.

The human settlements targets for Uthukela District Municipality include spatial intervention such as increasing the housing capacity of the municipality and densification at main centres to meet service delivery needs. The Roosboom area is one of the main centres identified for densification within Uthukela. Additional, the

Roosboom area forms part of the areas identified as provincial human settlements investment focus areas.

The **Provincial Growth and Development Strategy** commits the provincial government to ensuring that all households within the province have secure residential tenure and access to basic utility services.

This will be achieved through:

- Integrated Development Planning.
- Densification of settlement patterns.
- Slums Clearance.
- Improved access to basic services such as water, sanitation and electricity.
- Addressing the housing gap market.

The Roosboom Housing Project is a response to these provincial policy directives and provides for their attainment within the Alfred Duma Municipal area.

2.8.2 Need and Desirability

The Roosboom Housing Project is identified in the **Alfred Duma Municipality's Integrated Development Plan (IDP)**. The IDP, as a key strategic overall guiding framework of the municipality, identifies a need to facilitate the provision of adequate housing to all deserving citizens. Therefore, the proposed development can be seen as way of giving effect to one of the municipality's key strategic and long terms objectives. The proposed development forms part of the municipality's mission to ameliorate the standards of living within its area of jurisdiction by providing housing and basic service needs.

The municipality is cognizant of the fact that it has to provide housing that is sustainable and promotes easy access to opportunities. This is further emphasised in the municipality's RSDF.

The municipality's **Spatial Development Framework (SDF)** identifies the Roosboom area as one of the areas that require housing interventions within the municipality.

The project area falls within the broadest development vision of the municipality with regards to ensuring and facilitating the development of sustainable human settlements.

The SDF identifies Roosboom as a tertiary node within the municipality. This essentially locates the project area within the broader sphere of influence within the municipality.

SECTION THREE – DESCRIPTION OF THE ENVIRONMENT

3.1 Description of the Physical Environment

3.1.1 Climate

The proposed development site is located within the Subtropical Highland Climatic Zone (Cwb according to the Koppen climate classification) which experiences cool to cold winters and warm and wet summers.

Precipitation ranges from 600mm to 700mm per year (on average 639mm) and occurs during the summer months (Low & Rebello, 1996).

The majority of rain falls in the months of November, December and January. The winter months of July and August usually receive on average less than 9mm of rain (Environmental Potential Atlas for KZN).

Temperatures vary from -11°C to 38°C with an average of 17°C (Low & Rebello, 1996).

Extreme weather conditions include thundershowers, hail and fog.

Snowfall is rare.

3.1.2 Topography

The site can broadly be classified into eight (8) landscape units. These include

- Upper Plateau,
- Ridge/Koppie,
- Lower Eastern Plateau,
- Western Plateau,
- River Floodplain,
- River course (southern border),
- Non-perennial stream crossing site,
- Farm Dams & Wetland Seeps and
- Southern Plateau.

The **upper plateau** includes natural grassland that has been transformed in places by urban activities (soccer field, limited dumping and use a grazing lands). This area is generally flat to gently undulating.

The **Ridge/Koppie** comprises a change in gradient and is generally steeper. This area represents a no go area as it serves as habitat for woody species and several aloes.

Below the ridge/koppie, is a gently undulating to level **eastern plateau** that gradually extends south wards and toward the perennial river that makes the boundary of the site. This area is likely to include a **wide river floodplain** that may make access difficult.

Extending from east to west and bisecting the site is a **non-perennial water course**. This water course follows a shallow valley down toward the river course in the south.

This water course similarly offers constraints to development. **Farm dams and wetland seeps** are located at the top end and adjacent to this water-course.

The **western plateau** of the site also includes a uniformly steep topography. Development of this portion will trigger significant storm water management concerns owing to the steep gradient.

The **southern plateau** includes a gently sloping transformed area that has historically been affected by settlement activities and includes several existing houses, agricultural areas as well as a farm dam and transformed water course. This area will need to be accessed by crossing the Verbroekspruit and this may pose significant risks for flood and personal safety Impacts.

A **non-perennial tributary** (unnamed) of the Onderbroekspruit lies on the southern boundary of the site.

An unnamed **non-perennial watercourse** bisects the site from North West to South East. This stream has several seeps and wetlands in the headwaters and immediately upslope of the site.

A **small farm dam** is located within the site boundary within the upper western portion of the site. Similarly another farm dam and transformed water course lies within the southern extent of the site.

Wetlands and water sources are distinct habitat types identified by their position in the topography, presence of water or degree of saturation of the soil, nature of the soil present as well as type of vegetation occurring at a site. Riparian and wetland areas typically include a diversity of plant types, animal types and ecosystem processes that regulate the ecological integrity of a site or area.

Much like ridges, river courses are instrumental in allowing species movement and act as corridors between areas and habitats.

3.1.3 Surface Drainage Patterns

On a strategic level, no National Freshwater Ecosystem Priority Area (NFEPA) affects the site.

Two Sub quaternary catchments are however affected by the site namely catchments 3125 and 3296 which have a Freshwater Ecosystem Priority (FEPA) classification of “Upstream” which refers to an Upstream Management Area.

The site is bisected by two non-perennial water courses and smaller channels.

The site includes a farm dam and lies at the headwaters of a non-perennial stream that drains south eastwards into the Onderbroekspruit.

3.1.3 Geology and Soil Conditions

Appendix H1 and H2 includes a detailed site specific geotechnical assessment of the site as compiled by a professional geotechnical engineer.

Regional Geology

The 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.

Site Geology

Using trial hole data for the 42 sample test pits, a basic model of the site geology was compiled.

The different materials occurring on site that are essential to understanding the geotechnical zoning of the site, include the following (please refer to Table 3 in the geotech Report for a concise summary of the distribution of the soil types among the trial pits and Table 2 of the geotech report for detail of the test pit characteristics) -

Colluvium 1: The first colluvial material discerned across the site consisted of silty sand material which generally had a medium dense or dense consistency. The horizon was mostly characterised by dark grey or brown colour shades and had an intact material structure. Mixed gravel fragments were also commonly found in the horizon and most often consisted of shale gravel. As the material is of surficial distribution only, sampling was limited to a single sample. Test results confirmed that the material has a low heave potential as active clay content and a plasticity index of 8% and 4% were recorded, respectively. The material had a grading modulus of 0.96 and was awarded a PRA classification of A-4.

Colluvium 2: The second colluvial horizon discussed here includes an array of colluvial materials found across the site. All of these materials have the same core properties in that they consist of silty or gravelly sand with a loose or very loose consistency and intact structure. Material colours showed some variation and commonly included light grey, dark grey, light brown and dark brown. The material test result confirmed that this colluvial horizon is also unlikely to heave. Active clay contents ranged from 5% to 10%, while plasticity indices were below 4%. At least

one sample proved to be semi-plastic. The material had grading moduli between 0.72 and 1.08 and PRA classifications included A-2-4 and A-4. Two consolidation test sample were extracted from this colluvial horizon and the results proved that both samples are moderately susceptible to settlement under relatively low loads (e.g. 50kPa). Site observations also suggested that the colluvial material is dispersive. This observation was confirmed when double hydrometer test results recorded dispersion ratios between 57% and 84%.

Colluvium 3: The third colluvial horizon was discernible due to its tendency towards a cohesive material. Simply stated, whereas other colluvial materials were largely granular or sandy, this colluvial soil consisted of clayey sand material. As with materials discussed above, this horizon showed some variation in physical properties. The material mostly had a dark brown or dark grey colour, while a shattered structure and medium dense consistency were commonly recorded. Laboratory test analyses suggest the material is moderately expansive, with results indicating 27% active clay content and a plasticity index of 16%. In addition, the material had a grading modulus of 0.67 and was awarded a PRA classification of A-6. As with the colluvium 2 horizon the colluvium 3 material was proved to be dispersive, with test results revealing a dispersion ratio of 91%.

Ferruginised Colluvium: The ferruginised colluvium horizon occurred sporadically throughout the entire study area and was not only limited to lower lying areas. As the horizon was mostly of limited thickness, it was not sampled. Nevertheless, a general description recorded described the horizon as dark brown or grey gravelly or silty sand with black and/or orange discolourations. The horizon generally had a medium dense or loose consistency and intact structure, though a voided structure was occasionally observed. Critically, the horizon often contained gravel and cobbles of mixed origins (i.e. sandstone, shale and even dolerite).

Pedogenic Ferricrete Deposits: Pedogenic deposits – in the form of ferricrete – were identified in two trial holes. In trial hole eleven the pedogenic material consisted of nodular ferricrete with dark brown mottled black and orange colour, a dense consistency and an intact structure. In trial hole 37 the material also constituted nodular ferricrete and the material was described as dark brown mottled black and orange clayey, sandy gravel with a shattered structure and loose consistency. Due to its very limited occurrence, the materials were not sampled.

Calcified Residual Shale: Residual shale materials encountered in lower elevated parts of the site – most notably adjacent to the Onderbroekspruit – were found to be calcified. The light grey blotched white sandy clay had a stiff consistency and slickensided structure. This material was not sampled due to its limited occurrence, but the slickensided structure suggests that the material is expansive and therefore likely has similar properties to that of the uncalcified residual shale, as discussed below.

Residual Shale: This material was encountered abundantly across the study area and as is to be expected, physical properties also varied. The material generally had grey yellow or light grey colour and consisted of silty sand, gravelly sand or clayey sand, depending on its position on the site. For the most part the granular materials had a medium dense to dense consistency, while cohesive materials had a firm to stiff consistency. Intact or laminated structures were commonly identified. Laboratory test analyses proved that the material ranged from a low expansiveness (i.e. gravelly sand) to a medium and even high expansiveness. The test samples contained between 4% and 35% active clay content and had plasticity indices between 5% and 30%. These parameters confirm the high degree of variability in the weathering of the

materials. Grading moduli were between 0.50 and 1.18 and PRA classifications included A-4, A-6 and A-7-6.

Ferruginised Residual Shale: Ferruginised residual shale occurred more frequently than regular residual shale and while physical properties were often similar, the ferruginised horizon showed clear signs of discolouration or oxidation. This resulted in orange and black colour modifications but the horizon was often of a limited vertical thickness. Material test results showed that the material borders between a medium and high expansiveness. Active clay content of 28% was recorded, along with an associated plasticity index of 27%. The material had a grading modulus of 0.64 and was classified as A-7-6 according to the PRA classification system.

Residual Sandstone: Residual sandstone was encountered on limited occasions and generally showed the tendency to grade into weathered bedrock. For this reason the material was not sampled. For the most part the horizon had dark grey brown or light grey colour, an intact or laminated structure and a medium dense or dense structure. The material was also clearly micaceous, a feature originating from the micaceous nature of the parent material.

Ferruginised Residual Sandstone: This material again displayed colours and discolouration typical of ferruginised material. The horizon mostly consisted of clayey sand with an intact structure and medium dense consistency. A micaceous component was again observed in places. Laboratory test analyses indicated that three of the four test samples are moderately expansive, with the fourth having a low expansiveness. Active clay content ranged from 24% to 32% and associated plasticity indices were between 5% and 17%. The calculated grading moduli ranged from 0.61 to 1.04 and PRA classifications included A-4 and A-6.

Residual Dolerite: The penultimate material identified comprised residual dolerite, which was identified in two trial holes. The residual soil had clearly been chemically weathered to varying extents along the topography and as a result, the material ranged from silty sand to sandy clay. The residual horizons showed typical colour changes with depth, often seen in a dolerite profile with dark red being common closer to the surface and grading into a yellow brown or green grey material at depths. The cohesive materials had a soft consistency while granular materials had a medium dense consistency. An intact structure was recorded in all instances. Test results showed that that material has a medium to very high expansiveness, again, depending on the degree to which chemical weathering had proceeded. Active clay contents ranged from 23% to 37%, while plasticity indices were between 24% and 36%. The material had grading moduli between 0.21 and 0.66, while PRA classifications included A-7-5 and A-7-6. Corestones were commonly found in this horizon.

Ferruginised Residual Dolerite: This last material was found only in trial hole 40, where it occurred as orange brown speckled black clayey sand with an intact structure and medium dense consistency. As the material was only encountered on one occasion, it was not sampled.

As for Portion 502
“Colluvium: A surface colluvial horizon was identified in trial holes A, B, C,D and H. The horizon was between 300mm and 600mm in vertical thickness and had variable composition. The material was described as silty sand or clayey sand with light or dark grey colour. An intact or slickensided structure characterised this horizon, which also had a loose or medium dense consistency. While the observed slickensided structure suggests that the material may be expansive in places, the horizon is

generally of limited vertical thickness and occurs above conventional founding depths. Nevertheless, a sample of the silty sand colluvium was collected and proved to be non-expansive. The material had a semi-plastic nature and contained only 7% active clay content. A grading modulus of 0.65 was calculated and a PRA classification of A-4 awarded.

Alluvium: Alluvial materials occurred in all trial holes, except trial hole A The alluvium mostly had light grey brown or dark grey colour, often with white or orange discolourations (presumably due to ferruginisation and leaching). The horizon was described as being medium dense to very dense (when granular) or very stiff (when cohesive), while a slickensided structure was common. Though the base of the horizon was not always encountered before refusal of excavation was encountered, vertical thicknesses were between 200mm and 1500mm. Laboratory analyses confirmed that all samples of the alluvium are moderately expansive. Active clay contents ranged from 22% to 32%, with associated plasticity indices between 15% and 23%. The samples had grading moduli between 0.38 and 0.46 and were awarded PRA classifications of A-6 or A-7-6.

Residual Shale: The residual shale horizon was found in trial holes A and B, at higher lying parts of the site. The silty clay had light grey brown or orange brown colour, sometimes with black and light grey discolourations due to ferruginisation. A firm or very stiff consistency was recorded for this horizon, as well as a slickensided structure. Test results showed that this material is also moderately expansive with active clay content and a plasticity index of 43% and 21 %, respectively. The test sample had a grading modulus of 0.34 and was awarded a PRA classification of A-7-6."

Geotechnical Zones on Site

The study area can be divided into six (6) geotechnical zones:

Zone 1: ***R*** *or* ***S/R***: Zone 1 covers a large portion of the study area and is characterised by areas of bedrock outcrop, or areas with shallow bedrock and limited soil cover. In the latter case, soil movement in the soil material is expected to be limited to less than 10mm compression settlement. Of significance, though, is that the overburden material – especially in the northern parts of the study area – often contained oversized fragments (e.g. cobbles), which may cause differential settlement if founded upon. Localised areas in the southern parts of the site are also awarded this classification; however these areas have one notable difference in that overburden material had been removed by erosion, resulting in thinner soil profile overlying bedrock, compared with their immediate surroundings.

Zone 2: ***H1/R*** *or* ***S/H1/R***: This zone is distributed erratically across the site and is likely a function of topography, geology and weathering associated with drainage. Soil movement in this zone is expected to be dominated by unrestrained heave of up to 15mm (**H1**) while loose overburden in places may also see compression settlement of up to 10mm (**S**). Bedrock was proven in this zone at depths shallower than 1000mm, while localised bedrock outcrop was also encountered occasionally.

Zone 3: ***S1***: Zone 3 includes only trial hole fourteen and its immediate surroundings. The zone is somewhat peculiar as it is the only area in the study area where settlement of up to 20mm is expected to occur. It is likely, however, that more such areas may occur at localised positions in the study area and that such areas were simply not intercepted during the investigation.

Zone 4: ***H1-H2*** *or* ***S/H1-H2***: The areas included in this zone are mostly restricted to the southern parts of the study area where the soil profiles have been notably weathered. Expansive residual materials – originating both from dolerite and sedimentary bedrock – are expected to produce unrestrained heave between 7.5mm and 30mm. The vertical thickness and expansiveness of the materials combined are simply too variable to further separate the zone into more clearly defined areas (i.e. **H2** or **H3** only). Dispersive soils and erosion dongas occur in this zone, as illustrated in Photo 2.

Zone 5: ***H3***: Zone 5 includes the remainder of the site and is mostly distributed along the flanks of water courses. Soil profiles are deeply and extensively weathered, likely due to the effects of the adjacent water courses. A localised portion in the western corner of the site was also awarded this classification, but in this instance the profile consisted largely of expansive residual dolerite materials. It should be considered that a non-perennial stream occurs adjacent to this zone too, just outside the study area. Unrestrained soil heave in excess of 30mm is expected to occur in this zone, while erosion dongas and dispersive soils are also common.

Zone 6: **H2-H3**: The entire area of P502 is indicative of unrestrained heave of upto or exceeding 30mm. This zone is also susceptible to erosion, soil piping and it is expected that a substantial portion of the site may fall within the floodplain. Perched water or shallow seepage water within founding depths may also occur seasonally.

Table 5. Geotechnical zones located on the site (refer to **Figure 9)**

Zone	Class	% of Area	Soil Movement	Soil Profile	Development Potential	Construction Type	Foundation Design	Associated Problems
Portion 437 (80 Ha)								
1	R or S/R	44.1	Less than 10mm settlement	Limited colluvium overlying bedrock	Favourable	Normal	Strip footings or slab on the ground	Bedrock outcrop, Slacking Shale, Cobbles in overburden, Corrosive Soils, Possible seasonal groundwater
2	H1/R or S/H1/R	28.1	Up to 15mm unrestrained heave; less than 10mm settlement in places	Colluvium overlying residual soils with shallow bedrock in places	Favourable	Modified Normal	Reinforced strip footings	Sporadic bedrock, Corrosive Soils, Possible seasonal groundwater
3	S1	1.0	Settlement of upto 20mm	Colluvium overlying residual shales	Intermediate	Modified Normal	Reinforced strip footings	Corrosive soils; Possible seasonal groundwater Sporadic occurrence of zone
4	H1-H2 or S/H1-H2	10.6	Unrestrained heave of upto 30mm; less than 10mm settlement in places	Colluvium overlying residual profile (mixed materials)	Intermediate	Modified	Reinforced raft	Corrosive soils, Possible seasonal groundwater, Risk of flooding, Dispersive soils, Erosion dongas
5	H3	16.2	Unrestrained heave exceeding 30mm	Variable; mostly colluvium overlying mixed residual soils	Intermediate	Modified	Reinforced raft or Soil replacement raft	Corrosive Soils, Possible seasonal groundwater, Risk of flooding, Dispersive soils, Erosion dongas
Portion 502 (5.0 Ha)								
6	H2-H3	100	Unrestrained heave of upto or exceeding 30mm	Colluvium overlying	Intermediate	Modified	Reinforced raft or Soil	Corrosive soils, Possible seasonal

				alluvium and/or residual shale			replacement raft	groundwater, Risk of flooding, Dispersive Soils, Erosion dongas

Other Considerations

Ground Water & Expansive Soil

Perched Water: No seepage water was encountered in any of the trial holes excavated during the investigation. It must be taken into account, however, that perched groundwater is a strongly seasonal phenomenon which is most dominant between the middle and end of the rainy season, while mostly being absent during the dry season. In this instance, the investigation was conducted during the region's dry season. Considering the indicators observed in trial holes, it is expected that seasonally perched water may occur on this site and could potentially be very problematic.

Permanent Water: The probability for drilling successfully for water in the area to be more than 60% but the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths between ten and twenty metres in compact, dominantly argillaceous strata.

Stability of Excavations

Excavation Stability: Excavations made during the course of the investigation mostly proved to be stable. It is expected that perched or seepage water – if present – will severely detract from the excavation stability.

Wet Excavation: Depending on the outcome of a groundwater study, it may be required to make provision for wet excavation on a seasonal basis.

General Comments: Excavation by backhoe proved viable to depths between 300mm and 2400mm; however areas of bedrock outcrop may not be excavatible. 23 of the 45 trial holes (i.e. 51%) achieved depths of 1500mm or deeper.

Slope Stabilities: No natural slope instabilities were observed during the investigation.

Slaking Mudrock: Slaking mudrock was observed in the northern most portions of the study area in shale bedrock outcrop, as well as in the channel incisions of water courses.

Undermined Ground

The areas is not undermined

Sensitivity of the Soil Profile

Areas of Bedrock Outcrop: Though the proposed layout plan provided at the time of reporting seems to have taken into account areas of bedrock and associated steep slopes, it is worth discussing it here. While the sandstone or shale bedrock encountered in the northern parts of the study area are to a large degree manageable or workable, the dolerite outcrops are associated with steep slopes and very difficult excavation (to be discussed later). This area is therefore considered "least favourable" with regard to steep slopes and excavatibility and is generally not considered suitable for development, as already applied to the development plan.

Erodibility of Soil: Erosion in geotechnical zones 4 and 5 are associated with dispersive soils proved during the investigation. The erodibility of the soils is considered to be “high” and therefore this aspect is classified as “least favourable” for development. As with areas of steep slopes, the proposed township layout plan already takes into account the distribution of erosion features; however, measures will be required to ensure that erosion does not propagate further once the township has been established.

Insect Nesting: Insect nesting, such as ants and termites, was encountered sporadically throughout the site.

Eucalyptus Trees: Cognizance must be taken of the fact that clusters of eucalyptus trees occurred on the western and southern parts of the site. These trees are known to extract large volumes of groundwater. As a result, it is likely that there will be an increase in groundwater moisture levels when the trees are removed to make way for development. Care should also be taken to ensure that all roots systems are removed so as not to leave behind rotting remnants which will form sub-surface voids in the long term.

Steep Slopes

Parts of the site are affected by steep slopes. Slopes greater than 8% have been excluded as areas of development potential and rather included into the layout as Open Spaces. These areas typically are associated with ecological habitats and have been buffered by 15m to allow for natural functioning to continue.

Conclusion

Geology: The site is underlain by sedimentary bedrock materials of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. The sedimentary materials have been intruded by doleritedykes in places and covered by quaternary and alluvial deposits in lower lying areas.

Soil Profiles: Soil profiles across the site are variable but generally consist of colluvial cover overlying residual profiles of shale, sandstone and/or dolerite materials. Areas of bedrock outcrop occur on site.

Groundwater: Perched groundwater or seepage water was not encountered in trial holes, but it is expected that such water may occur on a seasonal basis and affect the proposed development adversely. The possibility and extent of such conditions remain to be verified by specialist studies.

Founding Conditions: The study area is divided into five zones, namely **R or S/R**, **H1/R or S/H1/R**, **S1**, **H1-H2 or S/H1-H2** and **H3**. Detailed site and stand zoning must be verified during a phase two investigation. The zoning must also be revised once flood line and groundwater assessments have been completed.

Conditions of Excavation: 51% of trial holes reached or exceeded a depth of 1500mm when excavating with a backhoe. Excavations are expected to be affected by seasonal groundwater influx and/or perched water levels. Conditions of clayey excavation may occur in most residual materials, while bedrock materials may need to be excavated or blasted.

Corrosivity: Some soil materials on site proved to be corrosive, mostly on account of high soil conductivity properties.

Historic Monuments: To the author's knowledge there are no historic monuments on the site.

Undermining: The area is not subject to undermining.

Dolomite Stability: The area is not subject to dolomite related instabilities.

Seismicity: A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.06g to 0.10g may take place once in 50 years.

Cemetery Sites: Numerous graves were identified by the site survey team and are indicated on the topographical survey plan.

Insect Nesting: Insect nesting, such as ants and termites, was encountered sporadically throughout the site.

Eucalyptus Trees: Cognisance must be taken of the fact that clusters of eucalyptus trees occurred on the western parts of the site.

Erosion and Dispersive Soils: Erosion dongas were found on site and are likely related to proven dispersive soil materials.

3.1.4 Description of the geohydrological Environment

A detailed geohydrological assessment of the site was conducted by a professional hydrogeologist (refer **Appendix L**).

According to the Hydrogeological map series (Esri Data & Maps) the site is underlain by an intergranular and fractured type of aquifer with average borehole yields of between 0.1 and 0.5 l/s.

The aquifers are described below:

- **Intergranular Aquifer**: A shallower, weathered zone, where the original rock structure has been changed to a mass of loose rock fragments, in a matrix of fine products of weathering, mostly sand, silt and clay;

- **Fractured Aquifer**: A fractured zone, down to a depth where the rock is becoming solid and fresh in appearance. The transition to this deeper zone is usually gradual.

Vulnerability indicates the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer.

Susceptibility is the measure of the relative ease with which a groundwater body can be potentially contaminated by anthropogenic activities and includes both aquifer vulnerability and the relative importance of the aquifer in terms of its classification.

According to the South African Aquifer System Management classification (Parsons, 1995) the aquifer is classified as a minor aquifer 2, with medium susceptibility to

contamination and moderate vulnerability 3. In addition to the published sources of information a qualitative assessment of the sensitivity and vulnerability of groundwater and surface water in the vicinity of the site was undertaken. When evaluating the risks arising from any possible soil contaminants and/or spills it is important to identify the key environmental receptors in the vicinity of the site, in particular surface water and groundwater, and to evaluate the sensitivity and vulnerability of those receptors. In this instance vulnerability is a measure of the potential for a release from the site actually impacting the receptor, i.e. is there a pathway from the site to the receptor.

Sensitivity is the measure of the degree of impact a release from the facility may have on a receptor. The sensitivity is related to the quality and use or potential use. Groundwater sensitivity at the site is classified as **high** as groundwater is utilised in the vicinity of the site to augment the municipal water supply which was reported to be erratic by residents. The vulnerability of the groundwater is also considered to be **high** as static groundwater depth was less than 10 m bgl and overlain by highly permeable or fractured materials.

The surface water sensitivity is considered to be **moderate** as the surface water bodies in the region is expected to be of deteriorated water quality although still important for residents. Surface water vulnerability is considered to be **high** as the perennial Onderbroekspruit is located on the southern boundary of the site.

The direction of groundwater flow is expected to emulate the topographical gradient which for the majority of the site slopes towards the south. As the site is located on a water divide groundwater flow is expected to flow to the north on the northern perimeter of the site. However, depth to groundwater could only be measured in one borehole and the exact nature and direction of groundwater flow is therefore not known. Considering the local geology and climate there is also a high likelihood that a perched water table could develop above the bedrock interface during the rainy season. As the current assessment was undertaken during the end of the dry season the presence of a perched water table could not be verified. The geotechnical investigation (Soil Kraft, 2017) also commented on the potential presence of a perched water table during the rainy season.

A total of seven boreholes were identified in the vicinity of the site but not within the confines of the proposed site boundary. Of the 7 boreholes 4 of these were not operational as they were either obstructed, destroyed, not installed with a pump or didn’t have functioning hand pump.

For the remaining three boreholes groundwater samples were collected from only 2 (labeled HBH1 and HBH3).

From HBH1 a pumped groundwater sample was collected directly from the outlet of the hand pump after community members pumped the borehole. The steel casing of borehole HBH3 was opened where after a grab groundwater sample was collected utilising a clean and dedicated bailer. The samples were submitted to an accredited laboratory, Aquatico located in Centurion, for the chemical analyses.

General Parameters

The groundwater samples complied to all the general parameters analysed for when compared to SANS 241 drinking water quality standards.

Anions

All constituents analysed for in both samples were compliant to the SANS drinking water quality standards.

Cations & Metals
All constituents were compliant with the SANS standards for the analysed samples.

Microbial Analysis
Bacteriological analyses identified microbial activity in both of the submitted samples with total plate count exceeding the SANS241 criteria. In sample HBH3 *E.Coli* was also identified that exceeded the SANS241 drinking water guidelines.

The most likely source of microbial impact to the groundwater has probably originated from the multiple pit latrines present at nearby properties. As there is no formal sanitary sewer network all residents have dug shallow pit latrines for the disposal of their excreta. For example HBH1 is located less than 20 meters downgradient of a septic tank. Generally buffer distances of at least 75 m from a borehole to the nearest pit latrine is recommended (*GW Protocol*).

Hydrocensus boreholes HBH1, 4, 5, 6 and 7 were all located within 75 m from a residential property that had a pit latrine. HBH3 that had the highest coliform count as well as detectable *E.Coli* but is not located close to a residential property. The closest upgradient development is the local school located roughly 170 m from HBH3.

HBH3 is however located adjacent to Onderbroekspruit and the deteriorated water quality observed in the borehole could be attributed to the potential deteriorated water quality of the Onderbroekspruit. The microbial impact has likely originated from pit latrines located within the upper drainage regions of the said surface water feature.

Water Classification
A piper diagram represents the chemistry of a water sample graphically. It is a trilinear diagram that implements major cations (calcium, magnesium, sodium and potassium) and anions (chloride, sulphate and bicarbonate) to reveal the chemistry of water samples. Sample HBH1 can be classified as sodium bicarbonate/chloride waters while sample HBH3 can be classified as a Magnesium bicarbonate type water.

3.1.5 Wetlands & River Courses

Appendix J includes a detailed assessment of the water courses and wetlands that occur within the study area. This assessment was compiled by a professional wetland ecologist.

Watercourses in the Study Area
There are no major perennial rivers in the study site. The closest major river is the Tugela (Thukela) River, which is approximately 8,5km south of the study site.

Most of the surface water eventually drains south into the Tugela (Thukela) River, with a very small portion in the north draining north and eventually into the Klip River. However, there are watercourses present on the site, with the semi-perennial stream (Onderbroekspruit) being the main watercourse.

The Onderbroekspruit (Stream), which is a fairly large system, flows from west to east through the southern area of the study site. There are also a few small drainage lines and wetlands present as well, most of which drain into the Onderbroekspruit

The study area is situated within the Primary Drainage Area (PDA) of V and the Quaternary Drainage Areas (QDAs) of V12F and V14B. The study area is within the Pongola-Mtamvuna (KZN Rivers) (WMA 4) and under the jurisdiction of the Pongola-Mtamvuna (KZN Rivers) (CMA 4). The study site is also not situated within a priority quaternary drainage catchment, in terms of guidelines and legislation from both the Department of Water & Sanitation (DWS). The table below gives a summary of the catchment areas and management areas for the study site (**Table 6**). The study area is within the wetland vegetation ecoregion of Sub-Escarpment Grassland (Group 2).

Table 6. Summary of Catchment Area information

Level	Category
Primary Drainage Area (PDA)	V
Quaternary Drainage Area (QDA)	V12F & V14B
Water Management Area (WMA) – Previous / Old	Thukela
Water Management Area (WMA) – New (as of Sept. 2016)	Pongola-Mtamvuna (KZN Rivers) (WMA 4)
Sub-Water Management Area	Upper Tugela
Catchment Management Agency (CMA)	Pongola-Mtamvuna (KZN Rivers) (CMA 4)
Wetland Vegetation Ecoregion	Sub-Escarpment Grassland Group 2
Fish FEPA	No
Fish Corridor	No
Fish Migratory	No
Catchment Area	No
Priority Quaternary Catchment	No
SWSA	No

The study site further does not fall within a Strategic Water Source area of South Africa (SWSA).

The geomorphology of the watercourses on site and immediate surrounding area is that of flat and undulating plains to steep gradients. The watercourses on site do not flow within deep or significant valleys or ravines, but are along fairly steep gradients. The geology common to the site is that of shallow to fairly shallow, coarse sands on hard, metamorphic bedrock. This geomorphology makes the area highly susceptible to severe erosion and donga formation. Over-grazing and over utilisation of the area results in large patches of denuded surfaces, which along with short, heavy rain downpours and steeper gradients, results in erosion. Damage of stream banks and denuded riparian areas has resulted in severe gully (donga) formation along the Onderbroekspruit. Accelerated surface stormwater flow into the river from steeper gradients and along hard open surfaces, like gravel roads, has aggravated the situation of erosion.

Delineation & Sensitivity Mapping of water courses

There are various watercourses present on the site, with the semi-perennial stream (Onderbroekspruit) being the main watercourse.

The Onderbroekspruit (Stream) flows from west to east through the southern area of the study site.

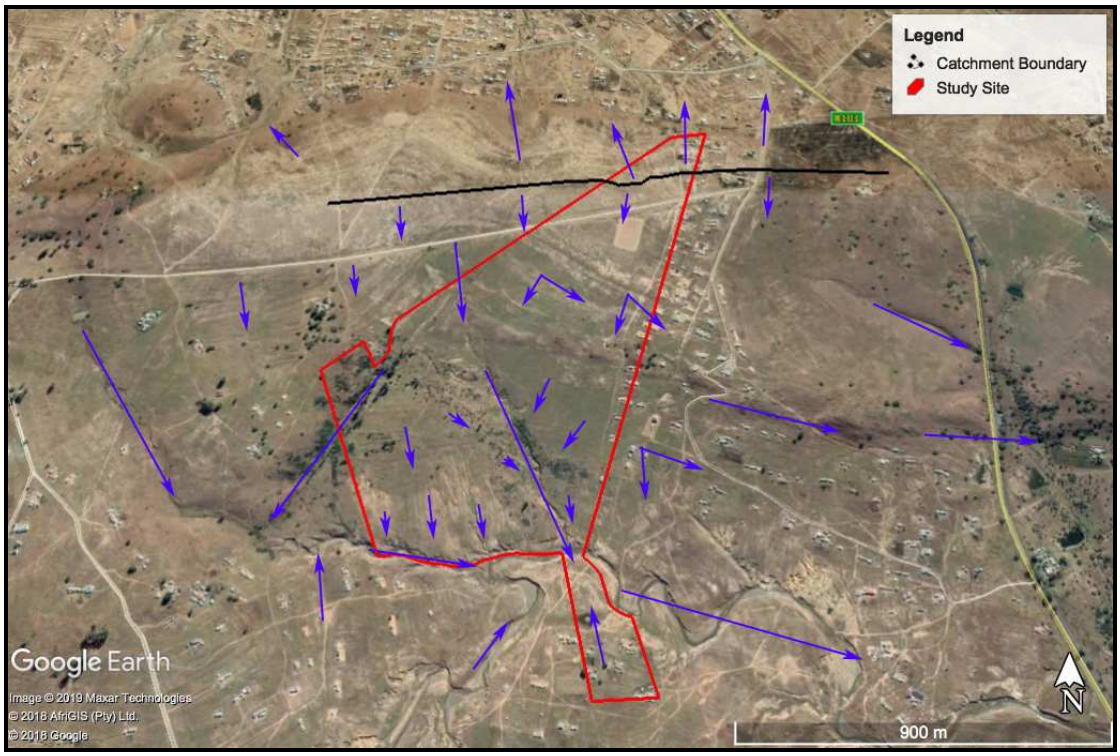
There are also a few small drainage lines and wetlands present as well, most of which drain into the Onderbroekspruit.

The watercourses have been delineated as shown in **Figure 13**.

Characterization of watercourses

The hydrology of the watercourses in the study site and immediate area are driven mostly by surface water and shallow sub-surface water flow and movement. The riverbed of the main watercourse in the area (the Onderbroekspruit) is broad, shallow, very sandy and fairly flat. This, along with the relatively small catchment area within the study site and immediate area, results in broken and seasonal water flow. The Onderbroekspruit does not have permanent or long periods of end-to-end flow through the area of the study site. The study site and associated watercourses are situated within the upper catchment area of the QDAs, which also contributes to irregular and more seasonal water flow.

The dominant flow of surface and shallow sub-surface water across the study site is south and east. A very small area of surface water flows north in the northern area of the study site. The figure below gives a general indication of flow directions.



Schematic illustration of the general flow of water across the site

Table 7. Classification of watercourses in the study area

Delineated systems	Level 1 System	Level 2 Regional Setting (Ecoregion)	Level 3 Landscape Unit	Level 4 HGM Unit
Onderbroekspruit (Stream)	Inland	Sub-Escarpment Grassland (Group 2)	Plain	River (Lowland)
Tributaries of the Onderbroekspruit	Inland	Sub-Escarpment Grassland (Group 2)	Plain	River (Lowland)

Valley Bottom Wetlands	Inland	Sub-Escarpment Grassland (Group 2)	Plain	Channelled & Unchannelled Valley Bottom Wetland
Seeps	Inland	Sub-Escarpment Grassland (Group 2)	Plain / Slope	Connected
Seasonal Drainage Lines	Inland	Sub-Escarpment Grassland (Group 2)	Plain / Slope	River (Lowland)

Present Ecological State

All watercourses identified and delineated within the study area were assessed to determine their Present Ecological State (PES) (**Table 8**). The assessment criteria and structure are based on the modified Habitat Integrity approach of Kleynhans (1996, 1999). The PES is calculated by looking at the hydrology, geomorphology, water quality and biota of each watercourse. Of importance is the overall PES of the system.

The most important and significant watercourse in the study area is the Onderbroekspruit. THe overall PES determination of the river is that of Category D (Largely Modified). However, the riparian area of the river, by itself, is badly disturbed and when calculating the riparian vegetation index (RVI), the riparian area has a PES (or RVI) of Category E (Seriously Modified) (see RVI calculations in the Appendices).

Table 8. PES of Watercourses in the study area

Criteria	Identified Watercourses				
	Onderbroek-spruit	**Small Streams**	**Drainage Lines**	**Seeps**	**Valley Bottom Wetlands**
HYDROLOGY					
Flow modification	2	2	2	3	2
Permanent inundation	2	2	2	3	3
WATER QUALITY					
Water Quality Modification	2	3	2	3	3
Sediment Load Modification	2	3	2	3	3
GEOMORPHOLOGY					
Canalisation	3	3	3	3	3
Topographic Alteration	2	3	2	3	3
BIOTA					
Terrestrial Encroachment	2	3	3	3	3
Indigenous Vegetation Removal	2	4	2	3	3
Invasive Plant Encroachment	3	3	2	3	3
Alien Fauna	3	4	3	4	4
Over utilisation of Biota	2	2	2	2	2
Total:	25	32	25	33	32
Average:	2,3	2,9	2,3	3,0	2,9
Category:	**D**	**C**	**D**	**C**	**C**
Description	**Largely modified**	**Moderately modified**	**Largely modified**	**Moderately modified**	**Moderately modified**
Recommended EMC	**C**	**C**	**C**	**C**	**C**

C = Moderately Modified; C/D = Border line between Largely & Moderately Modified; D = Largely Modified;
E = Seriously Modified

Ecological Importance & Sensitivity

The water quality of the small seasonal stream flowing north to south through the centre of the study is fair to good, with few pollutants. However, the macro-invertebrate biota is fair, but with low species richness due to the lack of permanent deep pools, aquatic plants, etc. The water quality of the Onderbroekspruit is poor due to various anthropogenic pollutants and lack of permanent strong flow, which helps to flush the system. The continued movement of free-roaming cattle in and through the main stream also results in polluted water from dung, etc. Siltation of the water is also problematic due to erosion. The aquatic flora and aquatic macro-invertebrate biota is poor, low and lack species richness due mainly to the watercourse not been perennial and lacking diverse, ideal habitats. The Onderbroekspruit is not an important fish river or corridor either.

The Ecological Importance and Sensitivity (EIS) values of the watercourses were determined as shown in the table below (**Table 9**). The Onderbroekspruit is a significant and important watercourse (river) in the area and study site and has a high EIS value. The drainage lines are typically short, very erratic and ephemeral in nature, only flowing for short periods of time after heavy rainfall and have a low EIS value. The wetlands are small and associated with streams and rivers. They are not significant in size or biodiversity richness, but do create important diversity in habitats, which are often important for various flora including aquatic species and waterbird species.

Table 9. EIS of watercourses in the study area

Determinants	Onderbroekspruit & Streams	Drainage Lines	Wetlands	Confidence
PRIMARY DETERMINANTS				
1. Rare & Endangered Species	2	1	1	4
2. Populations of Unique Species	2	1	2	4
3. Species/taxon Richness	3	1	2	4
4. Diversity of Habitat Types or Features	2	1	1	4
5 Migration route/breeding and feeding site for wetland species	3	0	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	3	1	2	3
7. Sensitivity to Water Quality Changes	3	1	2	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	4	1	2	3
MODIFYING DETERMINANTS				
9. Protected Status	0	0	0	4
10. Ecological Integrity	4	1	4	4
TOTAL	26	8	17	-
AVERAGE	2,6	0,8	1,7	-
Overall EIS	**B**	**D**	**C**	**-**

Description	High	Low	Moderate	-

Conclusion

The conclusions and recommendations arising from the study are as follows:

- There are a number of watercourses on site, including semi-perennial streams and drainage lines, all of which were delineated.
- The main watercourse is the Onderbroekspruit, which flows from west to east in the southern area of the study site.
- All watercourses are viewed as having a sensitivity rating of 'high sensitivity'.
- The township development will have an impact on the inflow, interflow and recharge of the watercourses in the study area. The increase in hard surfaces, impediments (houses, roads, etc.) will have a big impact on the present natural flow and movement of water through the study site and larger system, particularly in terms of surface storm water flow and shallow sub-surface drainage and movement.
- Erosion and gully formation is a major problem in the region and study site and must be prioritized during planning and construction.
- The PES and EIS of the watercourses on site are calculated as follows:
    - Onderbroekspruit: PES – D (Largely modified); EIS – B (High).
    - Other small tributary streams: PES – C (Moderately modified); EIS – B (High).
    - Wetlands: PES – C (Moderately modified); EIS – C (Moderate)
    - Drainage Lines: PES – D (Largely modified); EIS – D (Low).
- The most sensitive area in terms of potential negative impacts on the water environment is the semi-perennial stream flowing north to south down the middle of the site and into the Onderbroekspruit.
- Aquatic monitoring of all watercourses is required during the construction phase.
- A water use licence application (WULA) process is required for the project, as there is construction through watercourses (in the top north of the site) and within 500m of wetlands.
- Buffer zones (no-go areas) have been recommended around the watercourses.
- A 50m buffer zone (no-go area) has been recommended around the Onderbroekspruit, as it is the major water arterial through the area, while narrower 32m buffers have been recommended around the smaller, less significant watercourses.
- No development may take place within the recommended buffer zones, with the exception of very limited recreational structures for public open spaces.
- It is recommended that locally indigenous thorntrees be planted along some of the streams, in open public spaces and in areas with high erosion potential.
- A site-specific rehabilitation plan for all watercourses is required.
- A site-specific storm water management plan is required. The plan must address outflow points into watercourses (velocity, erosion, etc.). Furthermore, outflow must be spread along the length of watercourses and must not simply be concentrated and released at one point at the lowest downstream area. In other words, flow of water into the entire length of watercourses must be addressed and managed to maintain the integrity of the watercourses.
- There are no fatal flaws and the project may proceed, but only with the implementation of recommended mitigating and management measures.
- It is opinion of the wetland specialist that the proposed project (activity) and related activities should be authorised. However, all watercourses should be avoided and all recommended mitigating measures must be implemented and form part of the EMPr.

3.2 Description of the Ecological Environment

A SACNASP accredited professional natural scientist (botanical studies and ecological science) undertook a specialist investigation and assessment of the site during the summer months (refer to **Appendix I**).

3.2.1 Background Ecological Sensitivity

The South African National Biodiversity Institute (SANBI) developed a Land-Use Decision Support (LUDS) tool to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level. This tool serves as a guide for biodiversity planning but does not replace ecological assessments.

Important aspects provided by this tool included the following:

- The status of the land is classified as **Other Natural (Biodiversity) area**. This refers to areas that are 100% transformed according to KwaZulu-Natal landcover 2005.
- The site is not included as a Critical Biodiversity Area or Ecological Support Area;
- The site includes no Threatened Ecosystems;
- Similarly, no important Forest patches affect the site.

The Emnambithi Local Municipality (ELM) indicates that the land south of Ladysmith is classified as **Least Threatened**.

Even the site comprises a low sensitivity for terrestrial themes, a biodiversity assessment will never-the-less be undertake to assess the potential impact of the development on the current status, condition and sensitivity of the vegetation and ecological environment.

3.2.2 Flora

The site is located on Kwazulu-Natal Highveld Thornveld according to Mucina and Rutherford (2006). The conservation status of this vegetation type is Least Threatened.

Main factors that have altered this vegetation includes cultivation, urban sprawl and dams but also bush encroachment in heavily disturbed areas.

Two other vegetation types are located in close proximity to the site. These include the uThukela Thornveld to the east and Northern KwaZulu-Natal Shrubland west of the site.

These latter two vegetation types both have a conservation status of Least Threatened but of concern is that very limited land with this vegetation type is formally conserved.

Table 10. Conservation status of the vegetation types occurring the study area

#	Name	Conservation status	Conserved	% transformed
Gs6	Kwazulu-Natal Highland Thornveld	Least Threatened	2%	16%

SVs2	Thukela Thornveld	Least Threatened	-	5%
Gs5	Northern KwaZulu-Natal Shrubland	Least Threatened	>1%	3%

3.2.3 Endangered Ecosystems (as per Section 52 NEMBA)

In Notice GN 1002 in section 52 of National Environmental Management Biodiversity Act (No 10 of 2004), all the ecosystems are listed that are nationally threatened and in need of protection.

The Kwazulu-Natal Highland Thornveld is not listed as a Threatened Ecosystem in terms of this legislation.

3.2.4 Protected Areas

The site does not affect any Formal protected areas, Informal protected areas or National Protected Areas Expansion Strategy areas.

The closest protected area is the Nambithi Game Reserve which covers approximately 8 000ha of land. It is located approximately 25 kilometres east of Ladysmith. The big five occur on this reserve with over thirty other species of game. The Nambithi Conservancy is likely to incorporate the Nambithi Game Reserve.

3.2.5 Historical Status and sensitivity

According to Google images, land use on site has stayed very similar over the past 10 years with only a slight increase in rural houses at various points of the site.

3.2.6 KwaZulu Natal Biodiversity Guideline

This document provides several detailed guidelines that would have to be followed by the specialist assessing the natural environment.

Information from this guideline does not highlight any sensitive units for terrestrial or aquatic habitats affected by the development site.

A data request from KZN Wildlife for biodiversity information, indicated that the proposed development site does not fall within a Critical Biodiversity area. The SEA (Strategic Environmental Assessment, 2000) of the province, that modelled the distribution of a selection of 255 red data or endemic species, provided 4 species of concern for the area that is discussed in this report.

3.2.7 Vegetation Units

Six (6) vegetation units occur within the study area (refer to **Figure 11**). These include:

- Natural Grassland
- Rocky Woodland
- Eucalyptus grassland
- Central Rocky Ridge Grassland
- Stream and Wetland
- Disturbed Grassland

Natural Grassland

The larger part of the northern grasslands can be considered to be natural grassland. This means that the soil in these areas have not been ploughed or disturbed by housing or faming activities. At the time of the assessment, cattle was observed on site. The vegetation is however not considered to be in pristine condition due to constant grazing in the grassland area. It can be expected that constant grazing of the veld without veld rest will have affected the natural species composition of the original vegetation. Constant grazing benefits hardy species but causes other species to disappear from the area.

A range of natural forb and grass species was observed with limited to no exotic species present. Dominant forbs observed included the Asreraceae *Berkheya Echinacea* and *Helichrysum rugulosum* as well as *Hermannia depressa*. The grasses *Sporobolus africanus, Sporobolus pyramidalis* and *Aristida congesta* subsp *barbicollis* were the dominant species in the grassland. These are all impalatable grasses and Increaser 2 species, meaning that they increase with overgrazing.

The conservation status of this vegetation is considered to be Moderate.

Rocky Woodland

Rocky woodland occurred in the western corner of the site, in close proximity to what seemed to be an old farmstead's broken down buildings. The vegetation was characterized by woodland species such as *Searsia sp., Euclea crispa, Gymnosporia buxifolia and Aloe marlothii.* The herbaceous layer was poorly developed with a low species richness present.

The conservation status of this vegetation is considered to be Moderate as it provides a rocky, woody habitat for reptile, insects and possibly bird species that is not present in the neighbouring grassland.

This additional habitat value gives the vegetation unit an overall Moderate to Good conservation value.

Eucalyptus Grassland

The grassland in this part of the site was found to be disturbed, which allowed the infestation of exotic trees into the area. It is likely that the exotic trees originated at an old farmstead that was located in this area. A variety of exotic *Eucalyptus* sp (bluegum), *Lantana camara* (Lantana) and *Pinus sp* (Pine) trees, amongst others, has subsequently spread across the site affecting the natural species composition of this area. Species richness was subsequently found to be less diverse than in the natural grassland due to this disturbance.

The conservation status of this *Eucalyptus sp* grassland was found to be Poor.

Central Rocky Ridge Grassland

This narrow strip of rocky outcrop formed a natural landscape feature across the site. The vegetation included a diffirent set species to the surrounding grassland, due to more shelter for species from grazing and effects of fire. Prominent in the vegetation was *Aloe marlothii, Searsia rigida, Nuxia congesta* and *Euclea crispa.* In addition,

fern species such as *Pellaea calomelanos* and *Cheilanthes capensis* grew in the shade of the rocks.

The small extent, diffirent and diverse habitat provided by the rocky ridge, adds to the conservation value of this vegetation unit. It is considered to have a Moderate to Good conservation value.

Stream & Wetland

The edges of the smaller streams supported a small variety of wetland plants including sedges, rushes, wetland grasses and forb species. The small dam and wetland south of the Onderbroekspruit included a more homogenous wetland area including the wetland grasses such as *Leersia hexandra* and *Imperata cylindrica.* The Onderbroekspruit did not show a clear riparian edge due to erosion along the banks. Wetland type species were however present intermittently where wet areas occurred and soil was rich enough to support such species.

The conservation status of the wet areas on the site is considered Moderate from a vegetation point of view. The role of wetland features are however much more than plant species richness. These areas generally act as water source to faunal species in the area. In addition, the streams are corridors where fauna move when human disturbances, such as increase in houses, are prevalent.

The conservation status of the wet areas at Roosboom are therefore considered to be Good.

Disturbed Grassland

The lower end of the site along the Onderbroekspruit, was characterized by severe erosion, leaving these areas often void of all vegetation. The grassland species growing on the edges of the erosion dongas, resemble the disturbed grassland areas just north of the and south of the dongas rather than stream vegetaton. This grassland was found to be low in species richness with grasses such as *Melinis repens and Eragrostis gummiflua* being the prominent species in the grassland. These are both impalatable grasses and Increaser 2 species, meaning that they increase with overgrazing.

Overgrazing has several negative effects on the environment. Overgrazing causes the grass to be destroyed and the top soil to be washed away by water or blown away by the land. This leads to soil erosion and makes soil infertile which can eventually cause the desertification of the land.

The conservation value of the disturbed grassland is considered to be Poor.

3.2.8 NEMBA: Red Data Flora

Two Red listed plants were highlighted in the biodiversity information requested from KZN Wildlife namely *Barleria greenii* and *Bowiea volubilis*.

Barleria greenii is restricted to heavy, black clay soils on doleritic rock. It can be found in open rocky areas and is most abundant in moist areas such as along drainage lines or streams. No suitable habitat for this plant was observed on site. *Bowiea volubilis* is a hardy, deciduous, bulbous plant that climbs by means of its much-branched inflorescence. It often drapes over rocks and resembles a fine-

leaved asparagus. It grows in semi-shade or shade at the base of trees. The rocky woodland in the western corner of the site resembled habitat where this species may grow. It is suggested that this rocky habitat be conserved and protected for this reason amongst other.

3.2.9 Fauna

Birds

The habitat presented on the site for birds includes open grassland, rocky outcrops, wooded rock outcrops and tall exotic trees. Some pooling of water in the dams and along the streams provide some habitat for water birds, but this was found to be minimal.

A range of common bird species were recorded on site. These are listed in Table 2.

Table 11. Common bird species recorded on the site

Common name	Scientific name	Common name	Scientific name
Red-eyed Dove	*Streptopelia semitorquata*	Diderick Cuckoo	*Chrysococcyx caprius*
Yellow-fronted Canary	*Crithagra mozambicus*	Laughing Dove	*Streptopelia senegalensis*
African stonechat	*Saxicola torquatus*	Familiar chat	*Cercomela familiaris*
African pipit	*Anthus cinnamomeus*	Cape glossy starling	*Lamprotornis nitens*
Pied Crow	*Corvus albus*	Dark capped bulbul	*Pycnonotus tricolo*
Fork-tailed Drongo	*Dicrurus adsimilis*	Cattle Egret	*Bubulcus ibis*
Hadeda Ibis	*Bostrychia hagedash*	Egyptian Goose	*Alopochen aegyptiacus*
Red throated Wryneck	*Jynx ruficollis*	Bokmakierie	*Telophorus zeylonus*
Common Fiscal	*Lanius collaris*	Pied starling	*Spreo bicolor*
Redcollared Widowbird	*Euplectes ardens*	Eastern Clapper lark	*Mirafra fasciolata*

The pentad* information provided by the South African Bird Atlas Program 2 (SABAP2) affecting the site includes 2835_2940 and 2840_2940. Limited official bird assessments have occurred through the SAPA2 atlassing method in these two 9X9 km grid* areas, so a clear baseline of species potentially occurring in the area is not available.

While it is likely that a variety of raptor and even scarcer species may move through the area, or use the area, no specific species of concern were red flagged by KZN wildlife. The diversity of habitats on site is further low and the quality of the habitats have been reduced by anthropogenic influences which affects the use of the land by faunal species.

It is recommended that the riverine and rocky woodland areas be kept free from development to allow birds to continue to move through the area without hindrance.

Mammals

Mammal habitat on site included tall and short grassland areas, stream habitat, woodland areas and rocky outcrops.

Limited signs of faunal activity was observed. Signs of African Mole-rat (*Cryptomys hottentotus*) was observed. No mammals of concern was highlighted by the KZN database and it is subsequently no considered to be a concern for the proposed development.

Reptiles and amphibians

Limited reptiles were observed during the site assessment. There is however sufficient habitat on the site, including holes, cracks in rocks in the two rocky areas present to assume that several common species will be present. Species could include mostly snakes and adders, but also skinks and lizards. The rocky areas may provide more habitat than surrounding area for reptiles.

Amphibian species that may occur in the grassland and streams and in this area, include Common Platanna, Natal Ghost Frog, Bubbling Kassina, Rattling Frog, Yellowstriped reed frog, Gutteral and Raucous toad, Common river frog, Striped grass frog, Common Caco and Snoring Puddle frog. One small species of frog were observed likely to be the Snoring Puddle Frog (*Phrynobatrachus natalensis*). No amphibian species of concern were listed by KZN wildlife.

Arthropods and Molluscs

One arthropod species of concern was listed by KZN wildlife namely the scorpion *Hadogenes trichiurus pallidus.* All *Hadogenes* scorpions belong to the rock scorpion group and is a genus of large African scorpions found from South Africa up to Tanzania. They are easily identified by their very large pedipalps, thin tail, small venom vesicle, very flat appearance and elongated appendages. Their range is restricted to mountain ranges or discrete rocky outcrops. The rocky areas indicated in Figure 11 provides potential habitat for *Hadogenes trichiurus*.

One mollusk species of concern was listed by KZN wildlife namely the *Archachatina simplex,* a genus of large tropical air-breathing land snails. The Thukela agate snail Cochlitoma (formerly Archachatina) simplex is a species of snail that is only found in a relatively small area of KwaZulu-Natal (the Thukela Basin, roughly between Kranskop, Mooi River, Ladysmith and Nqutu) and nowhere else in the world. It's habitat is riverine thicket, bushveld and grassy savanna. If the species occurs on the site, a decision has to be made on how to conserve it (comms Adrian Armstrong Ezemvelo KZN Wildlife). The proposed development site is located on the edge of the broadly described distribution range. In addition, no riverine thicket, bushveld or strictly grassy savanna were present on site. The habitat on site resembled more open grassland, with small patches of rocky woodland and exotic bluegum trees. The site is not considered optimal for the Thukela agate snail, and no large snail shells were observed on site.

3.2.10 Ecological Sensitivity

Based on the assessment of the site and associated ecological aspects, the following sensitivities are allocated (**Figure 12**):

The Central rocky ridge grassland, Rocky woodland habitat and all wetland and stream habitats are allocated a High sensitivity.

The natural grassland is allocated a medium sensitivity and all the other areas are allocated a Low sensitivity.

The sensitivity assessment includes the provision of a buffer of 15m around areas of terrestrial ecological sensitivity. The non-perennial streams and wetland has been buffered by 32m whereas the riparian area has been buffered by 50m. The 1:100 year floodline has not been buffered but functions as its own buffer.

Table 12. Percentage of vegetation types occurring on the site

Unit	Size (Ha)	%	Status / Sensitivity	Allocated Buffer
Central Rocky Ridge Grassland	4.13	5.03	High	15m
Disturbed Grassland	18.6	22.68	Low	None
Eucalyptus Grassland	11	13.41	Low	None
Natural Grassland	39.7	48.41	Medium	None
Rocky Woodland	1.9	2.32	High	15m
Wetland and Stream Habitats	6.5	7.93	High	30m from stream/wetland and 50m from River
Total	**82**			

3.2.11 Conclusion

The proposed new Roosboom township is located in close proximity to other townships, but is still mostly rural in nature. Subsequently the natural elements present, should be considered and protected within the township layout where possible and practical.

The area where the township site is located consists of natural land and supports a variety of natural fauna and flora. The area is however not highlighted as a high priority conservation area, neither as an area where there is a major concern for sensitive natural species which can be impacted upon. The assessment of the site, indicated that sensitive species, should they be present, would more likely be associated with the rocky areas than the grassland areas.

Subsequently it is advised that the rocky areas as well as the stream areas be excluded as development areas, as these habitats will allow for continued use of the site by faunal and floral species presently making use of the site for the habitat and food requirements.

The value of the open land/open spaces for humans and nature, will have to be conveyed to future residents to ensure the sustainable use of these areas. This can be done through simple signage or environmental education through nearby schools and community centres.

In summary, there are no ecological aspects that would render the site unsuitable for development, if the more sensitive habitats are left undeveloped and protected within the site layout plan.

3.3 Description of the Social and Economic Environment

3.3.1 Regional Context

The site lies within the township of Roosboom that is regarded to be a peri-urban settlement that is still under traditional leadership.

According to the 2012/2017 IDP, historically Roosboom was one of a few areas where black people could purchase and own land in KwaZulu-Natal. However, in the early 1970s, pressure mounted to have the people of Roosboom removed.

More than 7,000 people were relocated in 1975 and 1976 to the newly-established Ezakheni Township. Although the land owned by all African landowners at Roosboom was expropriated by the government and reverted to state ownership, removals from Roosboom during 1975-76 did not completely uproot Africans from the land. A few scattered portions of land owned by Indian and coloured landowners were not affected by the removal and several new African families moved into their lands as tenants or simply as squatters.

In 1994, Roosboom was selected as one of ten nationwide RDP lead projects on land restitution. This meant that Roosboom land restoration was identified as one of the important projects for the aim of RDP and as such it would receive a special financial support for settlement planning and 106 infrastructure development. The number of households who had returned to Roosboom by 1992 was 177. It increased to 230 (1,380 people) by mid-1993 and 684 (4,310 people) in 1996.

Today, Roosboom has grown substantially in terms of both population size and extent of the area. In fact, it has become one of the peri-urban settlements in the ELM. Unless, outward growth and increase in density is managed, the area runs a risk of degenerating into a sprawling peri-urban slum.

Other rural settlements, such as Roosboom accommodate between 1.2 and 1.8 households per ha, which is relatively low-density developments. The urbanization processes in areas such as Ezakheni has resulted in the blurring of boundaries between rural and urban thus creating clusters of peri-urban settlements.

Efficient land management in peri-urban areas is critical to deal with challenges of socio-economic change. These areas act as an interface between rural, often informal tenure rights and institutions of enforcement on the one hand, and formal urban-based and mostly statutory law processes. They provide a unique opportunity for rural people to lead a generally rural lifestyle in an urban context.

Spatial planning interventions in these areas should focus on the formalization of these settlements through land tenure upgrading, provision of services, development of a range of housing products and improving access to public facilities.

3.3.2 Surrounding Land Use

The township of Roosboom lies mid-way between Ladysmith and Colenso on the R103/N11. Another town close to Roosboom includes Klippoort.

Roosboom can be described as a small settlement comprising rural residential land uses with a limited diversity of small and local services. The town of Roosboom includes a primary school, secondary school, community centre, various formal and

informal shops as well as bulk and local services for water and electrical supply. Only limited formal storm water systems occur within the adjacent town and no formal waste water treatment system is available in the area. That means that the standard method to treat sewage is by means of shallow conventional pit latrines and/or septic tanks. Grey water is normally decanted on site and into vegetable patches or vegetated areas. Solid waste, which is quite small in volume, is typically burnt, burried and thrown away. The majority of the surrounding areas have access to power and some have access to stand pipes for potable water use. Water is normally carried in containers to the household within 200m or greater distances from the stand pipe.

The Ladysmith Airport lies 7.5km north east of the site.

3.4 Description of the Cultural Historic Environment

A professional Cultural Historian compiled a Heritage Impact Assessment (in terms of Section 28(8) of the National Heritage Resources Act and the KZN Heritage Act (refer to **Appendix K1**). This further included an independent Paleontological Assessment (**Appendix K2**).

3.4.1 Survey Findings

Features noted during the survey including isolated undecorated ceramics and features relating to the built environment such as fence posts were recorded as Find spots and recorded with the pre-fix F and numerically numbered.

These find spots are of no heritage significance apart from mentioning them in this report.

Significant tangible heritage features such as burial sites and structures were recoded as sites with the pre-fix “R’ for Roosboom and also numerically numbered.

In addition to the graves recorded during this study, graves were noted by the surveyor and these locations are also included in this report.

A number of locations were identified across the survey area interpreted as grave sites. Some of these features are only marked by stone packed cairns and the possibility exists that not all of these could be graves but is handled as such until it is proven otherwise.

The area is characterised by the foundations of demolished structures. The structures’ potential to contribute to aesthetic, historic, scientific and social aspects are low, but sites like these are known to contain unmarked graves, usually of stillborn babies. In which case the sites would be of high social significance;

A total of 34 features were recorded including 13 find spots and 21 sites. **Figure 15** indicates sites of low, medium and high significance.

The features recorded are briefly discussed in the following sections.

Table 13. Find Spots recorded during the survey

Site Number	Description	Longitude	Latitude	Significance	Impact	Recommendations
F1	Ceramic shard	29° 43' 03.9107" E	28° 39' 41.3386" S	Low significance	Direct	No action required
F2	Stone fence post	29° 43' 17.7923" E	28° 39' 39.0707" S	Low significance	Direct	No action required
F3	Start of 350 m long collapsed stone wall	29° 43' 13.5192" E	28° 39' 36.9720" S	Low significance	Direct	No action required
F4	Large broken lower grind stone.	29° 43' 06.9529" E	28° 39' 37.7315" S	Low significance	Direct	No action required
F5	Continuation of 350m long collapsed stone wall	29° 43' 06.8627" E	28° 39' 37.3357" S	Low significance	Direct	No action required
F6	Stone fence post	29° 43' 09.5377" E	28° 39' 32.8140" S	Low significance	Direct	No action required
F7	Possible terraced area with loosely packed stone walling	29° 43' 01.4556" E	28° 39' 30.1933" S	Low significance	Direct	No action required
F8	Stone fence post	29° 43' 13.8611" E	28° 39' 27.9108" S	Low significance	Direct	No action required
F9	Stone fence post	29° 43' 07.5289" E	28° 39' 28.1375" S	Low significance	Direct	No action required
F10	Old water dam/reservoir.	29° 43' 05.0555" E	28° 39' 29.4371" S	Low significance	Direct	No action required
F11	Stone fence post	29° 43' 20.1432" E	28° 39' 30.8520" S	Low significance	Direct	No action required
F12	Old path or road	29° 43' 23.1167" E	28° 39' 27.8460" S	Low significance	Direct	No action required
F13	Old farm road entrance with stone fence posts and aloes.	29° 43' 22.6019" E	28° 39' 14.2631" S	Low significance	Direct	No action required

Table 14. Heritage Features recorded during the survey

Site number	Description	Longitude	Latitude	Significance	Impact	Recommendation
R1	Possible hut foundation	29° 43' 23.6459" E	28° 39' 51.1020" S	Medium Significance	Direct	The presence of graves should be confirmed through social consultation and the site should be monitored during construction.
R2	Small area of collapsed stone walling forming a square.	29° 43' 06.0673" E	28° 39' 37.6127" S	Medium Significance	Direct	The presence of graves should be confirmed through social consultation and the site should be monitored during construction.
R3	Multiple stone foundations. A stone fence post is also close to this point.	29° 43' 14.3041" E	28° 39' 34.8661" S	Medium Significance	Direct	The presence of graves should be confirmed through social consultation and the site should be monitored during construction.
R4	Possible foundation only visible through google earth historical view.	29° 43' 03.1430" E	28° 39' 33.0980" S,	Medium Significance	Direct	The presence of graves should be confirmed through social consultation and the site should be monitored during construction.
R5	Large foundation remains and a rectangular stone ruin.	29° 43' 04.8035" E	28° 39' 31.1580" S	Medium Significance	Direct	The presence of graves should be confirmed through social consultation and the site should be monitored during construction.
R6	Partial section of what seems to be an old canal build with stone.	29° 43' 02.0099" E	28° 39' 31.8025" S	Medium Significance	Direct	The presence of graves should be confirmed through social consultation and the site should be monitored during construction.
R7	Possible Graves	29° 43' 28.2397" E	28° 39' 27.1369" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained *in situ* with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to the graves.
R8	Large rectangular stone wall enclosure	29° 43' 27.8508" E	28° 39' 28.8792" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open

						public spaces. Family members should have access to graves
R9	Graves	29° 43' 22.9872" E	28° 39' 50.5836" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R10	Graves	29° 43' 07.0573" E	28° 39' 37.4832" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R11	Graves	29° 43' 05.6207" E	28° 39' 32.1299" S	High Social significance	Direct	Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to the graves.
R12	Graves	29° 43' 12.6731" E	28° 39' 31.7089" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R13	Graves	29° 43' 23.0412" E	28° 39' 24.2208" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R14	Graves	29° 43' 30.4896" E	28° 39' 07.8696" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R15	Graves	29° 43' 03.2812" E	28° 39' 39.0225" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R16	Graves	29° 43' 15.3009" E	28° 39' 35.0831" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R17	Graves	29° 43' 17.8487" E	28° 39' 42.4682" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open

						public spaces. Family members should have access to graves
R18	Graves	29° 43' 28.1807" E	28° 39' 54.0772" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R19	Graves	29° 43' 23.8533" E	28° 39' 54.1032" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R20	Graves	29° 43' 26.8873" E	28° 39' 54.9504" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves
R21	Graves	29° 43' 30.1004" E	28° 39' 58.1232" S	High Social significance	Direct	Confirmation from community members should be obtained on whether these features are graves. If confirmed - Graves should be retained in situ with a recommended buffer zone of 20 m incorporated into open public spaces. Family members should have access to graves

3.4.2 Built Environment

Remnants of several demolished foundations are spread over the study area. The structures' potential to contribute to aesthetic, historic, scientific and social aspects are low, but sites like these are known to contain unmarked graves, usually of stillborn babies. In which case the sites would be of high social significance and therefor the sites were given a medium heritage significance rating.

The area surrounding feature R5 is the most prominent with a graveyard, extensive stone wall foundations and features such as stone fence posts in the Western section. The features are degraded and there are modern modifications to some of the features. It seems that this cluster of sites was occupied over a long-time span and as recently as 2009 as the youngest grave within the graveyard is dated 2009.

Numerous find spots were recorded of low heritage significance consisting of stand-alone sandstone fence posts, agricultural terraces and linear stone walls demarcating boundaries.

Table 15. Recorded features relating to the Built Environment.

Site Number	Description	Longitude	Latitude
R1	Foundation of small circular stone feature, possible hut. Half buried stones with grass growing from the centre.	29° 43' 23.6459" E	28° 39' 51.1020" S
R2	Small area of collapsed stone walling forming a square.	29° 43' 06.0673" E	28° 39' 37.6127" S
R3	Multiple stone foundations. A stone fence post is also close to this point.	29° 43' 14.3041" E	28° 39' 34.8661" S
R4	Rectangular foundation only visible through google earth historical view.	29° 43' 03.1430" E	28° 39' 33.0980" S,
R5	Large foundation remains and a rectangular stone ruin.	29° 43' 04.8035" E	28° 39' 31.1580" S
R6	Partial section of what seems to be an old canal build with stone.	29° 43' 02.0099" E	28° 39' 31.8025" S

Table 16. Find spots relating to the built environment.

Site Number	Longitude	Latitude	Description
F2	29° 43' 17.7923" E	28° 39' 39.0707" S	Stone fence post
F3	29° 43' 13.5192" E	28° 39' 36.9720" S	Start of 350 m long collapsed stone wall

F5	29° 43' 06.8627" E	28° 39' 37.3357" S	Continuation of 350m long collapsed stone wall
F6	29° 43' 09.5377" E	28° 39' 32.8140" S	Stone fence post
F7	29° 43' 01.4556" E	28° 39' 30.1933" S	Possible terraced area with loosely packed stone walling
F8	29° 43' 13.8611" E	28° 39' 27.9108" S	Stone fence post
F9	29° 43' 07.5289" E	28° 39' 28.1375" S	Stone fence post
F10	29° 43' 05.0555" E	28° 39' 29.4371" S	Old water dam/reservoir. The inside of the dam is built with packed stones. The dam is built on a slope with only the Eastern side built up. The natural slope of the hill forms the western edge of the dam.
F11	29° 43' 20.1432" E	28° 39' 30.8520" S	Stone fence post
F12	29° 43' 23.1167" E	28° 39' 27.8460" S	Old path or road
F13	29° 43' 22.6019" E	28° 39' 14.2631" S	Old farm road entrance with stone fence posts and aloes.

3.4.3 Archaeological Resources

No significant archaeological sites or material was recorded during the survey. Therefore, no further mitigation prior to construction is recommended in terms of the archaeological component of Section 35 of the NHRA for the proposed development to proceed.

The lack of Iron Age sites in the study area is somewhat surprising as the general area is known to contain the remains of stone walled settlements. Two isolated find spots consisting of an undecorated ceramic piece and a broken lower grinder are tentatively classified as Iron Age as similar artefacts can be found on sites from the recent past. The lack of Stone Age lithics in the area can be attributed to the local geology with lithology consist mostly of sandstone and resulting in the lack of raw material suitable for knapping.

Table 17. Iron Age find spots

Site number	Description	LONGITUDE	LATITUDE
F1	Large piece of ceramic found among eroded material from a small gully.	29° 43' 03.9107" E	28° 39' 41.3386" S
F4	Large broken lower grind stone.	29° 43' 06.9529" E	28° 39' 37.7315" S

3.4.4 Paleontological Resources

An independent assessment was conducted by Prof Marion Bamford (2019). She concluded that the proposed site lies on the Late Permian Beaufort Group, Adelaide Subgroup, Normandien Formation (previously called the Estcourt Formation), sandstones, shales and mudstones.

Although fossils have not been reported from this site, there is a small chance that typical late *Glossopteris* flora plants could occur in the sediments just below the surface. Surface exposures are likely to be very weathered.

It is extremely unlikely that fossils would be preserved in the Quaternary sands and silcrete of the Masotcheni Formation (Bamford 2019)

3.4.5 Burial Grounds and Graves

Multiple locations were identified across the survey area that might be graves or grave like features. Most prominent was the graveyard at R11. The youngest grave within the graveyard is dated 2009 and the oldest grave within the graveyard is marked by a marble gravestone and is dated 1897. The areas with grave locations are highly overgrown and accurate grave counts were not possible.

Table 18. Burial sites recorded during the survey

Site Number	Description	Longitude	Latitude
R7	Rectangular stone packed graves	29° 43' 28.2397" E	28° 39' 27.1369" S
R8	Closed off area next to existing homestead. Area is demarcated by rectangular stone wall and fenced in with barbed wire. The area is overgrown. Some stones could be seen in the grass. The site could contain graves, but this should be confirmed with the community	29° 43' 27.8508" E	28° 39' 28.8792" S
R9	Rectangular packed stone feature orientated E-W. Possible grave	29° 43' 22.9872" E	28° 39' 50.5836" S
R10	Rectangular packed stone feature. Possible grave.	29° 43' 07.0573" E	28° 39' 37.4832" S
R11	Graveyard containing approximately 10-12 graves. Oldest grave dates to 1897.	29° 43' 05.6207" E	28° 39' 32.1299" S
R12	Rectangular stone packed grave.	29° 43' 12.6731" E	28° 39' 31.7089" S
R13	Packed stone feature under large thorn tree. Although unlikely could be a possible grave associated with another packed stone feature (dwelling foundation) 10m away SW.	29° 43' 23.0412" E	28° 39' 24.2208" S
R14	Stone cairns underneath Sisal - Possible grave	29° 43' 30.4896" E	28° 39' 07.8696" S
R15	Graves recorded by surveyor	29° 43' 03.2812" E	28° 39' 39.0225" S
R16	Graves recorded by surveyor	29° 43' 15.3009" E	28° 39' 35.0831" S
R17	Graves recorded by surveyor	29° 43' 17.8487" E	28° 39' 42.4682" S
R18	Graves recorded by surveyor	29° 43' 28.1807" E	28° 39' 54.0772" S
R19	Graves recorded by surveyor	29° 43' 23.8533" E	28° 39' 54.1032" S
R20	Graves recorded by surveyor	29° 43' 26.8873" E	28° 39' 54.9504" S
R21	Graves recorded by surveyor	29° 43' 30.1004" E	28° 39' 58.1232" S

3.4.6 Cultural Landscapes

Long term impact on the cultural landscape is considered to be negligible as the surrounding area consists of an area that has been subjected agricultural and road developments from prior to 1954. Visual impacts to scenic routes and sense of place are also considered to be low due to the other developments in the area.

3.4.7 Battlefields & Concentration Camps

There are no battlefields or concentration camp sites in the study area, although the following battles are indicated in the surrounding area dating to the Anglo Boer War (1899- 1902):

- uThukela
- Platrand
- Wagon Hill
- Vaalkrans Battlefields

3.5 Combined (Environmental) Sensitivity Mapping

The sensitive features relevant to the proposed development site and its surrounds were combined and illustrated on one sensitivity map to be able to indicate exactly where the sensitive areas are located on the subject site (**Figure 17**).

The following features have been used to create the sensitivity map –

- The 1:100 year flood line
- Sensitive Vegetation Units + 15m Buffer
- Watercourse + Wetland Habitats + 32m Buffer
- Riparian Area with 50m Buffer
- Geotechnical Zones
- Cultural Historic Resources + Buffers

The sensitivity map shows areas of High, Moderate and Low sensitivity.

The sensitivity map has been used to guide the layout of the proposed development area and this ensures that no areas of sensitivity are impacted upon.

These areas will be included into a Public Open Space that will offer habitat to local fauna and flora as well as cater for storm water run-off and localized flooding.

3.6 Conflict Assessment

Figure 18 illustrates the conflict assessment (i.e. where the proposed layout conflicts with the environmental sensitivities).

The conflict map shows that several areas exist where development was proposed and where sensitive areas exist. These included for example parts of the site where watercourses/wetlands and buffers occur, where the natural woody grasslands and ridge occurred and where several cultural historic features occur. In addition, the proposed layout impacted significantly on the 1:100 year floodline.

Consequently the layout was revised to ensure that the conflicts were either eliminated or minimized. Hence the preferred (alternative) layout has been compiled for the proposed development.

SECTION FOUR – DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOR THE EIA PHASE

4.1 Introduction

This section details the public participation conducted during the EIA Phase of the project. Details of the initial public participation undertaken during the scoping phase of the project are included in the Final Scoping Report compiled for the project. This document is available upon request.

The I&AP register and the Comments and Response Report have been duplicated from the Scoping Report for ease of reference.

The scoping that was undertaken by Eco Assessments served to inform adjacent land owners and other Interested and/or Affected Parties, which included the relevant authorities and community forums, on the proposed scale, nature and extent of the development and to provide these parties with the opportunity to comment on the proposed development.

For relevant detail, please refer to the Scoping Report and Plan of Study for EIA previously lodged with EDTEA.

4.2 Process of Engagement during the EIA Phase

The following process has been used to inform interested and/or affected parties of the proposed development:

- Focus Group Meetings with I&AP's to resolve issues, address concerns and discuss relevant comments;
- Provision of the draft EIA Report to registered I&AP's over a 30 day review period;

4.2.1 Competent authority consultation

On the 25th October 2019, an application for extension to lodge the Final EIA report was lodged with EDTEA (**Appendix A2**). EDTEA confirmed that the Final EIA report was to be lodged by the 25th February 2020.

4.2.2 Particulars of the Public Participation Process conducted during EIA Process

Proof for the distribution of the draft EIA Report to registered IAP's is provided in **Appendix N (to be provided in the Final EIA Report)**.

1. The Draft EIA Report was provided to all registered IAP by means of providing each with a dropbox link;

2. An electronic copy was also available for download via the Eco Assessments webpage www.ecoassessments.co.za.

3. A hard copy of the report was also provided to both the Public Library in Ladysmith as well as the Thusong Community Centre.

4. A hard copy & electronic copy of the report has also been provided to the following potentially affected State Departments:

   - Ezemvelo KZN Wildlife
   - KZN Department of Water & Sanitation
   - KZN Department of Roads & Transport
   - Alfred Duma Department of Development Planning
   - uThukela District Municipality

   Proof of the above notification process is provided under **Appendix N**.

5. I&AP's and State Departments were provided with 30 days in which to provide written comments to Eco Assessments.

6. By the 21st January 2020, six (6) parties had registered comments with Eco Assessments and these are provided in **Appendix P**. A summary of the main points raised by each party as well as the response to the comment is given in Table 20 below.

4.3 List of Registered I&AP's

Table 19 below provides a list of IAP's that registered during the scoping phase of the project.

Table 19. I&AP's that registered comments with Eco Assessments.

Date	Name	Organisation	Email / Cell or Fax
10th January 2019	Mr S Govender	DWS	govenders@dws.gov.za
14th January 2019	Mr N Bloy	PVT	Bloy.n@sna.co.za / 082 557 3188
16th January 2019	Mr Gumede	PVT	ziyekeletrading@gmail.com / 071 468 2077
17th January 2019	N Makhathini	PVT	Mnathis.donda@gmail.com / 072 582 3805
21st January 2019	Ms B Pawandiwa	AMAFA	bernadetp@amafapmb.co.za / 082 566 0884
22nd January 2019	Messrs M Nonku	PVT	magacheninonku@gmail.com
24th January 2019		PVT	064 972 4097
04th February 2019	Ms L Lauder	Sasol	Lyndsay.lauder2@sasol.com / 076 747 7621
11th February 2019	Ms J Reddy	KZN Transport	Judy.reddy@kzntransport.gov.za / 033 342 3962
17th February 2019	Mr Ntusi	PVT	076 616 8584
17th February 2019	Messrs Ghonlo	PVT	072 591 8609
17th February 2019	Cllr T Ngubane	Ward 13 Councillor	Twngubane@alfredduma.gov.za
13th November 2019	Ms B Warwick	Leads2Business	biancaw@l2b.co.za
02nd December 2019	Mr G Strinivasen	DWS	GovernderS2@dws.gov.za
02nd December 2019	Mr N Bloy		nbpmb@iafrica.com
02nd December 2019	Ms L Dladla	DWS	Dladlal@dws.gov.za
03rd December 2019	Mr J Reddy	DWS	reddyj@dws.gov.za
04th December 2019	Mr D Ramalingum	Uthukela District Municipality	dramalingum@uthukela.gov.za
09th December 2019	Ms J Reddy	KZN Department of Transport	Judy.reddy@kzntransport.gov.za
16th December 2019	AE Pauchcowrie		eliqimp@gmail.com
20th December 2019	Ms CL Dladla	DWS	dladlal@dws.gov.za
01 January 2020	Ms N Dlamini	Ezemvelo KZN Wildlife	Noluthando.dlamini@kznwildlife.com
07 February 2020	Ms N Mthembu	EDTEA	Nozipho.mthembu@kznedtea.gov.za

Table 20 provides a summary and response to the key issues raised by IAP's during the scoping phase of the project.

Table 20. Register of Interested and Affected Parties including a list of issues and the relevant response.

Comments raised on the scoping phase		
#	***Party + Comment/Concern raised***	***Response***
1	Mr S Govender Registered	Noted
2	Nr N Bloy I would like to register as an interested and affected party, due to the presence of a family grave yard on the farm. (I am not sure which portion of the farm it is on or if it is affected by your development?)	An independent cultural historic assessment will be undertaken and completed during the EIA phase of the project. The project would also then be registered with AMAFA / SAHRA. All relevant cultural historic resources will be considered and addressed in the layout and development process in terms of the National Heritage Resources Act.
3	Mr Gumede I hereby request for an application letter on propping to and in helping our environment grow and sustain a healthy life style. I therefore willing to work on cleaning the environment Rubble, Bush, cleaning and building. I believe my company has the experience and knowledge to overtake these sector.	Opportunities for employment and business opportunities were not the mandate of the EIA process. None-the-less his details were provided to the lead contractor and a commitment has been made (refer to notes of the public meeting) that local labour and resources would form a key component of this project.
4	N Mahathini I have two stands in the area of Roosboom and I am anxious if the building of the township will results in my land being expropriated. I would appreciate to be sent relevant documentation.	All details regarding the proposed development will be included in the Draft Scoping report. This will help answer your question regarding land ownership and expropriation. The town planner for the project has indicated that all relevant land onwers within the study area will be included into the development. This process will follow after the EIA decision.
5	MS B Pawandiwa Thank you for notifying Amafa. Please create a formal application and upload the EIA documents on which to comment on the SAHRIS Facility on www.sahra.org.za. Please include the following : • Site photos of the development footprint and the general surroundings. • Kml file map showing a polygon of the development footprint Proof of payment towards processing fee/handling fee.	An independent cultural historic assessment will be undertaken and completed during the EIA phase of the project. The project would also then be registered with AMAFA / SAHRA. All relevant cultural historic resources will be duelly considered and addressed in the layout and development process in terms of the National Heritage Resources Act.
6	Requested detail of the project and how they could benefit	Opportunities for employment and business opportunities were not the mandate of the EIA process. None-the-less their details were provided to the lead contractor and a commitment has been

		made (refer to notes of the public meeting) that local labour and resources would form a key component of this project.
7	Requested detail of the project and how they could benefit	Opportunities for employment and business opportunities were not the mandate of the EIA process. None-the-less their details were provided to the lead contractor and a commitment has been made (refer to notes of the public meeting) that local labour and resources would form a key component of this project.
8	Ms L Lauder No comment / not affected by the development	Noted
9	Ms J Reddy Registered as an IAP. Futher comment would be made once the application was considered.	Noted. A draft Scoping Report will be provided to the IAP in order to provide adequate information.
Public Meeting Comments		
10	Mr S Ntusi Queried the nature and type of relevant churches proposed in the preliminary layout	No definitive building style or type of church is proposed. The first step will be to identify areas where a church can be located and then find a developer/builder or church to construct the unit.
10	Mr S Ntusi Queried the extent of each stand	Each stand will have an approximate size of 300 - 400m^2. A house will be positioned on the stand. The house will be a standard low cost 2/3 bedroom, bathroom and kitchen house with a yard and garden area.
11	Messrs E Ghonlo How will the community be benefitted by the construction of the project?	The main contractor will be required to employ various local business people, builders, sub-contractors and workers to assist in the construction of the township. This will also include on-site training and support.
12	Cllr Ngubane Several households may have invaded the site and these will need to be accommodated without encouraging or promoting new people occupying the land	A process will be undertaken during the awarding of land to relevant beneficiaries to ensure that current occupiers and/or owners of land within the current study site, will be appropriately accommodated in the township. This process will run once the EIA process has concluded.
Comments raised in the EIA Phase		
#	**Party + Comment/Concern raised**	**Response**
1	Bianca Warwick (Leads2Business) Requested to be registered as an IAP	Noted and added as an IAP
2	Mr S Govender (DWS) Registered	Noted
3	Mr N Bloy Requested that his email address be amended on the IAP register	Noted and changed
4	Ms L Dladla (DWS)	

	Requested that a hard copy of the report be provided for comment purposes	A hard copy was provided on the 28th November 2019.
5	Mr D Ramalingum (Uthukela District) The UDC had no objection to the proposed development. The following comments were made - The liberation of dust into the surrounding environment must be effectively controlled Noise disturbance must be kept to minimum Chemical toilet facilities or other approved toilet structures must be provided All refuse pending removal must be stored in a container and must be disposed of at a recognised disposal facility Portable water must be provided A storm water management plan must be implemented Measures must be taken to prevent the pollution of ground and surface waters No environmental degradation must take place	 Noted The EMPr includes detailed mitigation measures that will be used mitigate nuisance dust impacts (refer to **Section 6**) Chemical toilets will be provided for staff during the construction phase and Lined VIP toilets erected on each erf for the operational phase (refer to Section 6) Skips will be used during the construction phase to temporarily contain waste&refuse. Each erf is provided with a yard for refuse temporary storage. Waste to be collected as part of local collection systems (refer to Section 6) Potable water is to be provided as 200m stand pipes. This has been confirmed to be adequate. Pleasse refer to **Appendix E** that includes a detailed SWMplan. The recommendations of the Geohydrogical Assessment and Wetland Assessment have been included into the EMPR (Section 6) that provide measures to monitor, mitigate and manage impacts on the ground and surface water environment. The EMPr in Section 6 offers measures to monitor, mitigate and manage the construction and operational activities such that impacts on the environment are acceptable and do not lead to the degradation of the site and its surrounds.
6	Messr AE Pauchcowrie Requested an electronic copy of the Draft EIA report.	Electronic copy of the main EIA report was provided. The party was also provided with details of the comment process and where documents could be obtained for comment.
7	Ms N Dlamini (Ezemvelo KZN Wildlife) Noted that the comments provided on the 07th July 209 still stand.	These comments had previously been considered and addressed in the Draft EIA report and this response is thus considered adequate and appropriate.
8	Ms J Reddy (KZN Department Transport) Noted that they had received the Draft EIA	Noted. No such comment was ever

	report and that appropriate comment would be provided accordingly.	received as of the close of the comment period on the 21st January 2020.
9	Ms CL Dladla (DWS)	
	1.1 The applicant must note that (several) activities constitute water uses and must be authorized by this Department, under the provisions of the national Water Act (Act No. 36 of 1998), hereinafter referred to as the NWA. The river, stream and associated buffers must be treated as sensitive environment areas, caution must be exercised near the watercourses. The applicant must note that any activity within a 500m radius from the boundary of a wetland requires a Water Use Authorization in terms of the Section 21c and I of the NWA.	A Water Use License specialist will be appointment to investigate which water uses, as listed under Section 21 of the NWA, will be triggerd and that may require authorization. This will include th preparation of a complete water use authorization application, including relevant documents and detail.
	1.2 The Department would like to emphasize that a Water Use Authorization will be required in terms of the Section 21b of the NWA for the "Roof water and road surface water that will be channelled towards armourflex storm water channels which reduce erosion on site as well as conveying the water to attenuation ponds strategically located around the site to attenuate the run off discharge before it is let out to the nearby stream as a controlled rate"	The relevant water uses will be included into the water use authorization application.
	1.3 The applicant must note that should you engage in any water use without the necessary water use authorization, it will be regarded as an unlawful water use. The Applicant will thus be guilty of an office and liable for a fine or imprisonment as stipulated in Section 151 of the NWA.	Noted.
	1.4 A pre-water Use License Application meeting is recommended. The Applicant is required to contact Ms Zamashenge Hadebe of the Water Use Authorization Unit on 031 336 2700 or hadebez@dws.gov.za.	The water use license specialist will arrange to meet with DWS when necessary.
	1.5 It is the responsibility of the Applicant to identify all water uses applicable to the activity in terms of Section 21 of the NWA and ensure that all applicable water uses are authorized as such. The Applicant must consult this Department if clarity is required with regard to water uses and water use authorisations. The onus is on the	Noted.

	Applicant to submit a complete Water Use Authorization Application to this Department for water uses under Section 21 of the NWA that will be exercised in time to avoid unnecessary delays. 2.1 The Applicant is required to provide this office with the Map for this development (preferable an A2 size or bigger). Such map should, amongst others (2.1) show all water courses within and around the site of interest; and (2.2) show the 1:100 year flood line of all watercourses (in and around the site) or 100m distance (which ever is the greatest distance) 3.1 The requirements of this Department with respect to solid waste must be strictly enforced and complied with. 3.2 The applicant should note that contaminated soil or other hazardous material must be disposed of at a permitted hazardous landfill site that is authorized to accept that said material and proof of this must be made available to this department when required. The recycling of suitable material is encouraged by this Department, provided it is properly managed. 4.1 For the waste water and effluent disposal that make use of septic tank and French drains treatments system, the following issues should be addressed as per the second edition of DWA's Protocol to manage the potential of ground water contamination from onsite sanitation facility: The Sanitation Project Implementation plan which encompasses the ground water protocol report should be submitted at DWS, and must include the following: • Borehole in the vicinity • Surface water sampling and testing (nearby resources) • Ground water sampling and testing (nearby resources) • Potential Risk • Likely risk areas, low risk area, medium risk area and high risk area • Frequent monitoring plan, micrtobial and physical chemical • Depth of the pit design and volume • The maintenance plan The sanitation project implementation plan document should be accompanied by the covering letter from the Municipality which acknowledges that the Municipality concedes, aware and approve of the	A relevant sized map will be provided with the water use authorization application. A geohydologist will be commissioned to compile a specialist report that addresses these requirements as part of the water use authorization application.

	sanitation project. 4.2 Department requires the Applicant to ensure to ensure that toilets are located out of the 1:100 year flood line; 4.3 It is this Departments experience that projects of this nature may result in the generation of volumes of water containing waste. In this instance, the following is applicable: Water containing waste must not be discharged into the natural environment; Measures to contain the water containing waste and safely dispose of it must be implemented. 5 Relevant specialist reports must accompany the Water Use Authorization application. Compliance to the final approved EMPr must be audited regularly by the designated Environmental Officer. 6 This office reserves the right to inspect the site without prior notice in order to ensure that its requirements, as mentioned above, are adhered to. Should any problems be noted, measures must be undertaken immediately to rectify the situation. 7 This Department reserves the right to revise / withdraw these comments and request further information from the applicant should any other information that contradicts the above come to light.	All these toilets are located outside the 1:100 flood line level. As water will not be piped to each erf, the risk and impact of uncontrolled grey water draining into the environment is low as only limited water volumes will be available for discharge. The soils and geology of the site are also likely to be able to absorb the water load and are unlikely to result in grey water run off that will impact on any water courses. Noted. Noted Noted
10	Ms N Mthembu (EDTEA) B. The exact size of each proposed house must be confirmed with the municipality and included in the final EIR; C. The layout plan must be legible with legends easily linked to activities components as per Appendix 1 3(l)(i)(iii) requirements. C. Erf 508 and Erf 509 must be classified as High Sensitive Cultural Historic Areas and appropriate mitigation measures must be recommended. C. The final preferred layout plan must be updated, to reliable the environmental sensitivity units and also clearly indicate the various categories on the layout C. The attenuation ponds must be clearly relabelled in the layout plan. C. The Final EIR must provide detailed drawing of the structures that will be put within a watercourse for the proposed construction of the road across the stream. C. The final layout must be signed by the	The exact size for each household can not be provided as each varies in extent. The ruling size is between 200m^2 and 400^2 with an average of 300m^2 (refer to **Appendix C**) for details of the town planning application. This size of property has previously been agreed to by the Alfred Duma Local Municipality; Refer to Figure 6 that includes all the relevant described to occur on site. Refer to Figure 6 that shows these two erven having been zoned as Open Space to protect the features; Refer to Figure 6 that clearly illustrates the buffers zones, sensitive areas and features of the site. Please refer to Figure 6 that clearly shows the position of each attenuation pond. Please refer to Appendix E6 that shows the infrastructure proposed for the stream crossing. Please refer to Fig 6 that is signed by the

	engineer/town planner or the municipality	Civil Engineer
	D. All comments from IAP's received should be included and responded to in the FBAR (FEIR). The issues raised by the IAP's should be addressed and integrated into the impact and mitigation measures in the EMPr;	Please refer to **Appendix P** that provides a copy of the relevant comments and Table 20 (above) that responds to the relevant comment.
	D. The PPP must comply with regulation 41 of GNR 326 of Regulation 2014 as amended;	Noted.
	D. Department of Water and Sanitation must be contacted for comment on the draft EIA report;	Please refer to **Appendix P**
	D. Proof of circulation and receipt of the document must be attached on the final EIR;	Please refer to **Appendix O**.
	E. The EMPr must be updated to ensure all contact details are provided and that it is signed as per Appendix 4 of the EIA regulations;	Please refer to **Section 6** that includes the relevant contact details and signature,
	E. The EMPr must include the maintenance of the ablution facilities during the operational phase	Please refer to **Appendix M2** that includes a maintenance schedule.
	F. The maps attached in the report must be printed in colour and the legend must be easily readable	Noted.
	F. All specialist studies must comply with Appendix 6 GNR 326 of EIA Regulations 2014	Please refer to **Appendix N**.
	Geotech Report is not dated, no declaration, cv or expertise are attached on the report	Please see the updated **Appendix H1** and **H2** that also includes the CV of the specialist.
	Wetland Impact Assessment Page 2 of the report indicate the field investigation was undertaken between 20 and 21 March 2019, while page 3 states 2nd of August 2019 as the date of the site investigation. Clarity must be given on when the site investigation was undertaken.	Please refer to the corrected **Appendix J** that confirms the site visit to have occurred on the 20 and 21 March 2019.
	1. Failure to include the abovementioned during the EIA phase will result in no authorization being issued by this Department until such information is provided	Noted
	2. Please note that the project stated above may not commence prior to the relevant authorization being granted by this Department	Noted
	3. The Department reserves the right to revise or withdraw these comments should any other information that contradicts the above come to light;	Noted
	4. Contact this Department if you have any queries regarding this correspondence.	Noted

Table 21. Key issues identified based on the comments received

Issue	Nature of Issue	Response
o Access to jobs and business opportunities	o A large number of people in and around the area do not currently have employment. The project could potentially provide a number of jobs and/or business opportunities that would benefit the community.	o The proposed layout includes options for business and other land uses that may allow for employment opportunities.
o Details of the application including extent and nature of proposed land uses	o Several IAPs required access to additional details of the project.	o This will be provided as part of the continued process of engagement with registered IAP's as well as the broader community.
o Illegal occupation of land and access to beneficiaries and current land owners/occupiers of the land	o The study site is currently under the ownership of the Alfred Duma Municipality and is not fenced. The opportunity for land invasion exists.	o The Municipality has, over a number of years, been in contact with current land owners, prospective beneficiaries as well as registered beneficiaries to ensure an equitable and fair process of access to land ownership on the site.
o Risks to cultural historic features that occur or may occur on site	o Several cultural historic features occur on the site. These include at least 8 graves, a cemetery, old farm buildings and areas with cultural historic value. Where-ever possible, these features will need to be retained in situ and the layout developed to mitigate impacts on these areas.	o A detailed Heritage Impact Assessment has been undertaken to assist in this process. The layout plan illustrates where these features occur and how they have been protected in the layout.
o The development is likely to trigger water uses and these will require approval by the KZN Department of Water and Sanitation	o A non-perennial stream and water course traverse the site. The site also includes wetland habitat. These will each be affected by infrastructure that includes a road crossing, storm water attenuation structures and anti-erosion measures. Similarly the underlying aquifer is sensitive and may potentially be affected by the VIP toilets and temporary storage of solid wastes.	o A water use authorization application will have to be compiled and lodged for the appropriate activity. This must include a detailed layout plan as well as a Sanitation Project Implementation plan. The outcome of the application will be provided to EDTEA once the response from DWS has been provided.

SECTION FIVE – ASSESSMENT OF ENVIRONMENTAL ISSUES AND POTENTIAL IMPACTS

5.1 Assessment criteria for the Impacts

As a means of determining the significance of the various impacts that can or may be associated with the proposed development, a series of assessment criteria were used for each impact. These criteria include an examination of the nature, extent, duration, intensity and probability of the impact occurring, and assessing whether the impact will be positive or negative for the natural as well as biophysical environments at, and surrounding, the site.

That which follows provides the rules and guidelines that were used to assign a particular rank to the impact variable and these have been adapted from those proposed in the **Department of Environmental Affairs EIA Guideline Document (April 1998).**

5.1.1 Nature

This is an appraisal of the type of effect the activity would have on the affected environment. This description includes what is being affected and how.

5.1.2 Extent

This indicates the spatial area that may be affected by the impact and further describes the possibility that adjoining areas may be impacted upon. This includes four classes that are listed as follows:

- Local (i.e. extending only as far as the site);
- Limited (i.e. limited to the site and it's immediate surrounds);
- Regional (i.e. extending beyond the immediate surrounds to affect a larger area);
- National or International.

5.1.3 Duration

This refers to the period of time that the impact may be operative for (i.e. the lifetime of the impact). This includes the following four classes that are listed as follows:

- Short (i.e. 0 - 5 years);
- Medium (i.e. 5 - 15 years);
- Long (i.e. > 15 years and/or where natural processes will return following the cessation of the activity or following human intervention);
- Permanent (i.e. where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient).

5.1.4 Intensity

This indicates whether the impact is likely to be destructive or have a lesser effect . Three such classes of intensity are defined and these are listed as:

- Low (i.e. where natural, cultural and social functions and processes are not affected by the development);

- Medium (i.e. where the natural, cultural and/or social functions and processes are affected by the development but can continue in a modified way);
- High (i.e. where natural, cultural and/or social functions or processes are altered to the extent that it will temporarily or permanently cease).

5.1.5 Probability

This refers to the likelihood of the impact actually occurring. The following four classes are used to describe the probability of the impact:

- Improbable (i.e. low possibility of the impact);
- Probable (i.e. a distinct possibility exists that the impact will occur);
- Highly probable (i.e. more than likely that the impact will occur);
- Definite (i.e. the impact will occur regardless of any preventative mitigation measures).

5.1.6 Significance

The significance of the impact (i.e. whether it will lead to a marked change in the environment or not) is determined though a synthesis of the aspects produced in terms of their nature, duration, intensity, extent and probability. Four classes of significance exist including:

- None (i.e. the impact will not have an influence on the decision and requires no mitigation);
- Low
- Medium (i.e. it is likely to have an influence on the decision and requires mitigation);
- High (i.e. Mitigation is required and this may not be sufficient to ensure that the environment is not detrimentally affected by the proposed development).

5.2 A Description any Assumptions, Uncertainties and Gaps in Knowledge

An assessment of the impact the proposed development may have on the environment includes evaluating the impact according a series of assessment criteria. This has been undertaken by considering the effects that may result should the impact occur. This was evaluated according to the input received from I&AP's and on the basis of experience gained from similar projects.

The relevant issues have each been assessed taking into account information obtained from the applicant, I&AP's and specialist input.

Table 22. Summary of Key Environmental Issues & Specialist Investigation to be considered in the EIA Phase of the project

Key Issue	Description / Comment	Specialist Investigation and/or Assessment undertaken
Steep slopes	The site includes a ridge/rocky outcrop as well as steep slopes	A slopes analysis was used to indicate areas of opportunity/constraint The ridge/rocky outcrop was investigated by a specialist ecologist
Geotechnical limitations	The site includes hard rock areas as well as clays/wetlands	A qualified geotechnical engineer undertook a geotechnical assessment of the site. This ascertained areas where the soils and/or geology may

		constrain development. In addition the assessment determined if any key construction limitations or opportunities exist on the site. This includes for instance the presence of road building materials, occurrence of hard rock, areas of limited or non-excavation, areas of clay, etc.
Watercourses including wetlands, farm dams, rivers and non-perennial water courses	The site is bisected by a non-perennial water course. Farm dams are located on site Several wetlands are likely to exist at seepage points A river course lies on the southern boundary of the site	A qualified wetland ecologist assessed the site to determine the location and extent of any wetlands, watercourses or seeps that occur on the site, and within 500m of the site. This assessment followed the DWAF 2006 Guideline to delineate surface water resources. Prescribed buffers were adopted to ensure that the water resource is adequately protected from development activities. This further included an assessment of the status of the watercourse as well as likely impacts that the proposed development may have on the watercourse. Crossings of watercourses were investigated and addressed in terms of relevant applications with DWS and NEMA
Indigenous vegetation	The development will clear more than 20ha of indigenous vegetation. The site does not fall within a CBA area as it is ranked as least concern The ridge/rocky outcrop includes possible habitat for sensitive species	An ecological assessment was undertaken in the summer months (Nov to April) in order to ascertain the presence/absence of any rare and/or endangered species (fauna as well as flora) as well as verify the location, extent and status of the ecological units that occur on site. A vegetation assessment was undertaken to verify the location, extent and status of the indigenous vegetation that occurs on site. Relevant red data plants/animals were assessed by an ecologist to assess the potential impact of the development Sensitive areas were mapped and buffered.
Cultural Historic features	The site includes several graves although no historic buildings or archaeological features	A qualified cultural historian (archaeologist and palaeontologist) assessed the study area and locate any cultural historic features that occur on site. This included a detailed survey of the site, mapping features of significance and compiling a Phase 1 Report. Should any graves or any other cultural

		historic features be located in the site that cannot be included into the development plan, then a Phase 2 assessment will need to be followed so that they may be relocated and/or removed from the site.
Agricultural Resources	The site is used for grazing and small scale agriculture The soil is generally unsuited for agricultural production owing to its sandy/rocky substrate	No specialist investigation was undertaken. Data was provided via Ezemvelo/ENPAT to verify the agricultural potential of the site
Electrical Services	A powerline bisects the site A substation is located north of the site that can provide a link service to the site	An electrical engineer investigated the opportunity for link services and the capacity of the sub-station to cover peak Requirements for relevant upgrades were investigated Crossings of watercourses were investigated and addressed in terms of relevant applications with DWS and NEMA
Potable Water	A potable water line bisects the site along the gravel road in the north	A civil engineer investigated the opportunity for link services and the capacity of the existing reservoir (off site) to provide for peak Requirements for relevant upgrades were investigated Crossings of watercourses were investigated and addressed in terms of relevant applications with DWS and NEMA
Sewage Treatment	No bulk facility occurs on site or in the surrounding areas Currently adjoining properties make use of pit laterines or French drains	A civil engineer investigated options to cater for sewage disposal/treatment. This included a Ventilated Improved Pit Laterines and/or Installation of bulk facilities.
Roads / Access	A gravel road and a small local track occur on site The nature of the development excludes traffic generators (i.e. retail activities like shops, malls, filling stations, office blocks, etc.) All roads are proposed to be gravel for local use	The civil engineer undertook a traffic statement and designs to cater for the low traffic anticipated Crossings of watercourses were investigated and addressed in terms of relevant applications with DWS and NEMA
Social Cost & Impact	The site is located adjacent to the township of Roosboom A rural residential area lies west of the site whereas both formal as well as informal settlements occur east and north of the site The proposed settlement is not likely to impact on the	No specialist investigation was deemed necessary to consider and address the relevant social benefits and/or disadvantages surrounding the development as it has largely been evaluated as part of the RSDF process for the area and site.

	character of the area	
Storm Water Management	No storm water infrastructure occurs on site except for isolated swales that drain water from the gravel road A non-perennial water course bisects the land. The southern boundary of the site is bordered by a water course. A farm dam is located on the western extent of the property	A suitably qualified civil engineer ascertained the 1:100 year floodline level for the non-perennial stream that bisects the site as well as the perennial stream that lies on the southern border of the site. The Civil Engineer (CE) also modelled the predicted run off from the site in order to ascertain the appropriate Storm Water Management measures to attenuate flows so as to prevent flooding. Besides attenuation, the CE also included measures to retain water run off from the site as well as retain water in the relevant dams, ponds and structures across the site. The discharge point for each outlet was also adequately designed to prevent erosion impacts.
Geohydrological Impact	The use of pit latrines on the site could potentially impact on the aquifer and give rise to ground water pollution	A geohydrologist undertook an assessment of the aquifers on site and evaluated the current and potential impact of pit latrines on the ground water quality.

5.3 Impact Assessment

5.3.1 Risks of structural collapse, settlement and heave

Status Quo Conditions (i.e. relevant information)

The site comprises a geotechnical condition that is rated with favourable or Intermediate development potential.

No dolomite or undermining occurs on site or in the immediately surrounding areas.

Parts of the site have dispersive soils and others around the river course include soils with potential and likelihood for heave.

A number of mitigation measures are prescribed to ensure founding conditions are satisfactory and to eliminate the risk of collapse, settlement and heave.

Impact Assessment for the Development Phases

Construction
A number of activities could potentially impact on worker health and safety during the construction activity if pick and shovel excavation is undertaken in specific areas such as this with cobble stones, hard rock and/or Hard Soil.

Generally it is recommended that all excavation occur as mechanical excavation.

In some cases this will require blasting as the rock may be shallow. Furthermore risks may emerge during wet excavation where accumulated soil water may need to be pumped out to dry the excavation. The presence of core stones may also require the use of larger excavation equipment to allow effective removal.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Geological Collapse	Site	Short	High	Medium	High	Medium

This impact is considered to be of High significance and will require mitigation. This would include following proper procedures during blasting events as well as appropriate excavation techniques depending on the material substrate being excavated.

Operational
As no dolomite occurs in the area, no sink hole impacts during the operational phase are likely to occur. This is because the soil is regarded to be stable and the area has not previously been mined to cause surface artefacts or impacts that may give rise to events such as wall and road cracking, building collapse or similar events.

However, parts of the offer risks to heave and limited settlement collapse owing to the nature of the founding soil profile. In the event that inadequate foundations are provided for in the construction of the houses, then the houses may develop cracks due to differential settlement. Similarly pipes, services, and other structures may also be impacted upon.

Storm water impacts during the operational phased may further include the creation of gullies and erosion channels especially on soils that are weathered and/or susceptible to erosion. Mitigation measures must therefore be used o stabilize these areas.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Geological Collapse	Site	Long	Medium	Likely	Moderate	Low

This impact is considered to be of Moderate Significance before mitigation and will require mitigation.

Recommended Mitigation Measures

Taking into consideration the findings of the geotechnical investigation, the following general recommendations can be given as guidelines:

Geotechnical Zone 1: ***R or S/R***
Founding in this zone may be done by means of slab on the ground, or normal strip footings hosted on bedrock. Bedrock must be inspected and approved as suitable for construction by a competent person. Care must be taken to remove oversized rock fragments from the building foundations as founding on such cobbles may result in differential settlement and structural distress.

Geotechnical Zone 2: ***H1/R or S/H1/R***
Founding in this zone can be done by means of reinforced strip footings. This method sees founding by means of reinforced strip footings capable of accommodating up to 15mm unrestrained heave and (where relevant) up to 10mm settlement. The superstructure is to contain articulation joints at all internal and external doors and openings, as well as lightly reinforced masonry. As before, care must be taken to remove all cobbles from the building footprints.

Geotechnical Zone 3: ***S1***
In this zone founding can be done by means of reinforced strip footings capable of accommodating up to 20mm compression settlement. Foundation pressures should not exceed 50kPa. The superstructure should contain articulation joints at all internal and external doors and openings, as well as lightly reinforced masonry. As before, care must be taken to remove all cobbles from the building footprints.

Geotechnical Zone 4: ***H1-H2 or S/H1-H2***
It is anticipated that founding in this zone may be done by means of a reinforced raft capable of accommodating up to 30mm unrestrained heave and foundation pressures not exceeding 50kPa. The raft must also be able to accommodate up to 10mm compression settlement. The superstructure must contain articulation joints and masonry must be lightly reinforced. Floor slabs must be fabric reinforced.

Geotechnical Zone 5: ***H3***
Founding in zone 5 must be done by means of a reinforced raft capable of accommodating unrestrained heave exceeding 30mm. The exact amount of heave must be determine for each stand during the phase 2 geotechnical investigation, but as a guideline, maximum unrestrained heave of up to 90mm is expected. The superstructure must contain articulation joints and masonry must be lightly reinforced. Floor slabs must be fabric reinforced.
As an alternative, a soil replacement raft may be considered, if economically viable.

General Remarks
Site drainage of this area must be planned carefully and no storm water or surface water should be allowed to accumulate within 1.5m of individual structures.

The anticipated soil movements, geotechnical zoning and proposed foundation precautions are summarised in the attached Table 5: Foundation Design, Building Procedures and Precautionary Measures. *It is essential that zoning and individual stand zoning be verified during a phase two geotechnical investigation in accordance with SANS634.*

Considering the parameters of "Conditions of Excavation" as per SANS 1200, one must allow amongst others the following for the prevailing site conditions:

Colluvium and Ferruginised Colluvium: All colluvial materials are considered machine or hand excavatible. Provision should be made for the excavation and removal of cobbles and for this reason hand excavation is not recommended.

Pedogenic Ferricrete Deposits: The pedogenic materials are considered machine excavatible. Hand excavation is not recommended.

Residual Shale Materials: The residual shale, calcified residual shale and ferruginised residual shale materials all proved to be machine excavatible. Due to the materials' consistency and composition, hand excavation is not recommended in this material and it is also recommended that provision be made for clayey excavation if materials are encountered in a moist to wet state.

Residual Sandstone: The residual sandstone is considered partially machine excavatible as it grades into weathered bedrock. The use of larger excavation equipment (e.g. excavator) may be more effective when excavating through this material. Hand excavation is not recommended; however refusal of excavation is expected to occur despite using larger equipment.

Ferruginised Residual Sandstone: The ferruginised residual sandstone should best be excavated using mechanical equipment and provision should be made for possible clayey excavation if the material is found in a moist to wet state.

Residual Dolerite and Ferruginised Residual Dolerite: These materials proved excavatible by machine and should preferably not be excavated by hand due to its clayey consistency and the inclusion of cobble-sized corestones.

Shale Bedrock: The shale bedrock is considered partially excavatible by backhoe and would be more so using an excavator. However the material is bound to induce refusal of mechanical excavation at some point. The bedrock varies from very soft rock material to potentially hard rock material where it has undergone contact or heat metamorphism. Blasting may be required in case of the latter scenario.

Sandstone Bedrock: The sandstone bedrock materials have roughly similar properties to the shale bedrock as far as excavatibility is concerned.

Dolerite Bedrock: The dolerite bedrock encountered in outcrop on site is considered very hard rock and will require blasting or chemical dissolution to remove.

Corestones: The presence of dolerite corestones was proven during the investigation. The corestones were generally limited in size and could be managed by a skilled backhoe operator, though it is anticipated that some corestones may require larger excavation equipment to allow effective removal.

Excavation Stability: Excavations made during the course of the investigation largely proved to be stable. It is expected that perched or seepage water – if present – will severely detract from the excavation stability and would necessitate remedial steps (e.g. pumping dry excavations).

Wet Excavation: Depending on the outcome of a groundwater study, it may be required to make provision for wet excavation on a seasonal basis.

General Comments: Excavation by backhoe proved viable to depths between 300mm and 2400mm; however areas of bedrock outcrop may not be excavatible. 23 of the 45 trial holes (i.e. 51%) achieved depths of 1500mm or deeper.

Slaking Mudrock: In order to avoid a reduction in bedrock competence, it is recommended that shale (and to a lesser extent sandstone) bedrock exposed to atmospheric conditions should be exposed for the shortest time possible to prevent slaking.

Safety: The safety of all persons working in or near open excavations must be ensured.

Soil Corrosivity
Provision must be made to protect metallic objects (e.g. services, utilities, anchoring cables, etc.) which are buried below ground level from corrosive soils and possible exposure to seasonal groundwater. It is recommended that protective coating be considered for piping. Alternatively, the use of PVC pipes may be considered.

All services must take into account the expansive nature of some in situ soils to avoid being damaged or disrupted by soil heave.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction				√	Medium
Operation			√		Low

5.3.2 Risk of Pollution/Contamination of Ground Water

Status Quo Conditions (i.e. relevant information)

The geotechnical studies (Soil Kraft, 2017 and 2019) revealed the majority of the site is underlain by limited colluvium overlying bedrock (sandstone and shale) and colluvium overlying residual soils with shallow bedrock in places. The site is underlain by an intergranular and fractured type of aquifer with average borehole yields of between 0.1 and 0.5 l/s. The aquifer is classified as a minor aquifer, with medium susceptibility to contamination and moderate vulnerability.

Groundwater sensitivity at the site is classified as **high** as groundwater is utilised in the vicinity of the site to augment the municipal water supply which was reported to be erratic by local resident. The vulnerability of the groundwater is also considered to be **high** as static groundwater depth was less than 10 m bgl and overlain by highly permeable or fractured materials. The surface water sensitivity is considered to be **moderate** as the surface water bodies in the region potentially has deteriorated water quality. Surface water vulnerability is

considered to be **high** as the perennial Onderbroekspruit cuts through the project site at the border between farm portion 437 and 502.

The direction of groundwater flow is expected to emulate the topographical gradient which for the majority of portion 437 slopes towards the south. As the site is located on a water divide groundwater flow is expected to flow to the north on the northern perimeter of portion 437. As for portion 502 groundwater flow is anticipated to flow towards the north towards the Onderbroekspruit.

The site currently lies vacant although a few isolated houses are located on the eastern portion of the site. The surrounding area comprises a peri-urban landscape with several houses scattered across the landscape. None of these units have access to a water borne outfall sewer or other means of sewage treatment. All make use of pit latrines and/or French drains and septic tanks. Consequently the aquifer at and around the site is largely fair to poor owing to elevated risks of microbial contamination. This appears to be a direct due to both faecal bacteria from human as well as animal excrement.

Impact Assessment for the Development Phases

Construction
No groundwater will be abstracted during the construction period of the proposed development. During the primary construction phase, the site will be prepared and levelled and services will be installed on the site. These activities will be undertaken with the help of heavy machinery including back-actors and bull dozers. The creation of impervious areas will restrict the infiltration of water into the sub soil and this may impact on the water table.

A contractor's camp will be erected on site for the duration of the construction phase. Owing to the fact that machinery will be utilised for construction purposes, the possibility of oil and fuel spillages remains. However, in order for the ground water to be contaminated, large quantities of oil/fuel will have to seep through the soil. With the proper precautionary measures (drip trays, concrete bunded areas) in place it is unlikely that groundwater contamination will occur on the site and therefore the proposed development is not likely to have any detrimental impacts on the groundwater resources of the area.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Ground Water Pollution	Site	Short	Medium	Likely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Operational
The most likely impact on the ground water regime will include the potential leakage of the VIP Latrine system that is proposed for the site. Contaminated sewage water (effluent) from the pit could potentially seep into the fractured and integranular aquifer and thus contaminate ground water resources. The probability of this occurring is low as the containment pit is to be constructed of re-enforced concrete that would thus be a sealed unit. The potential impact from earthquakes or ground collapse is small, hence the risk of collapse is also small.

Furthermore, few of the surrounding land users make use of the existing boreholes in the area for potable water and the characteristics of the aquifer suggest that the aquifer can reduce the migration of nitrate, chloride and phosphate.

Other sources of potential contamination may include -

On site grey water disposal
Household waste pits
Cattle Kraals
Graveyards

The overall risk for the development to contaminate the underlying aquifer regime was therefore considered to be medium and some precautionary measures will have to be implemented.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Ground Water Pollution	Region	Long	Medium	Improbable	Medium	Low

This impact is considered to be of Moderate significance before mitigation.

Recommended Mitigation Measures

Ensure that adequate provision is made for storm water run-off.

Ensure that oil/ fuel spillages from construction vehicles and machinery are minimised and that where these occur, that they are appropriately dealt with (i.e. by drip trays, concrete bermed areas).

Drip trays must be placed underneath construction vehicles when not in use to contain all oil that might be leaking from these vehicles.

All fuel tanks must be bunded to 110% of the capacity of the tank in order to contain any spillages that might take place. The combined volume of fuel stored on site may not exceed $80m^3$.

A fuel jockey system must be used (where applicable) to limit impacts such as regular spillage, leakage and excessive heavy vehicle movement.

Considering the potential presence of a perched water table during the rainy season, which could impact on the foundation designs and geotechnical specifications, it is recommended that a limited groundwater study be undertaken during the rainy season. The study should include the installation of shallow hand augered soil bores above bedrock to verify whether shallow groundwater is present;

It is recommended that grey water volumes are incorporated into the design calculation to allow for more accurate estimation of clean out schedules. This should be done so that no overflowing of the containment pits occur which could contaminate surface and groundwater at and near the development;

An overarching operational and maintenance plan needs to be developed detailing as a minimum the sequence of collection and inspection of sanitary infrastructure, safe disposal procedures for waste, emergency spill response procedures and assigned roles and responsibilities;

It is recommended that the Alfred Duma municipality agree to the proposed operational and maintenance plan;

Although the detected microbial impact has been identified for boreholes located outside the proposed development is it recommended that the Alfred Duma Local Municipality are made aware of the identified microbial impact to groundwater and the state of community wells that require their attention;
Sanitation facilities should be well maintained and serviced, any breakages or leaks should be fixed immediately to prevent loss of containment;

Consideration should be given to the implementation of a groundwater monitoring network (As per Section 7.5 of this report) to ensure that the development will have minimal impact on the underlying aquifer. Considering that water supply to the area has been reported as erratic it might be advantageous that some of the groundwater monitoring points be converted to boreholes to serve as an alternative water supply to the local community.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction			√		Low
Operation			√		Low

5.3.3 Risk of Air Pollution (Dust, Smoke, Emissions)

Status Quo Conditions (i.e. relevant information)

The study area is located adjacent to the urban area of Roosboom that includes a majority of residential uses in a generally per-urban landscape. No large industries or business areas occur in proximity to the site. The majority of land owners on the area also have access to a power supply and therefore smoke emission is generally isolated and limited.

Similarly the site is not affected by any large industrial or other users. Hence the ambient air quality is generally good to very good. Factors that may reduce the overall air quality include the infrequent movement of vehicles along the gravel roads that may give rise to air pollution and/or the higher volume of vehicles and heavy vehicles that move between Ladysmith and Colenso. This road however is located more than 500m west of the development area.

Impact Assessment for the Development Phases

Construction
The impacts of the proposed development on the air quality of the area would be associated with the primary construction phase. During this phase, a significant amount of dust may be generated by the machinery used to level and prepare the site for the construction of the actual structures/buildings.

When the primary construction phase comes to an end, the impact of dust generation will become less significant. For this reason it is imperative that appropriate measures to control nuisance dust be used during the construction phase. This would include the regular wetting of access roads during the dry summer and windy months of the year.

An additional impact on the air quality is the increase in vehicle exhaust fumes that will be experienced during the construction period. It is therefore imperative that all machinery and vehicles on site is road worthy and do not give rise to excessive smoke or emissions.

No fires or other forms of air emission are envisaged during the construction phase.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Air Pollution	Region	Short	Medium	Likely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Operational

The impact during the operational phase is likely to be low to none owing to the low intensity use anticipated for the site. The development proposes to supply electricity to each unit and therefore carbon emissions and smoke is expected to be small. This may however increase during the winter months should households make use of coal stoves and this could lead to temperature inversions and limited impacts on the air quality in the region.

The development is also likely to increase the use of cars and taxis along the gravel road and this would increase impacts associated with air pollution due to airborne dusts. The anticipated increase in vehicle movement is however not likely to exceed levels that could not be naturally tolerated by the open nature of the surrounding area.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Air Pollution	Region	Long	Low	Likely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

Wet all exposed sand areas such as roadways, stockpiles and working areas that give rise to dust during the movement of construction vehicles as well as windy conditions. Water for wetting the soil must not be sourced from the existing stream or boreholes on site, unless with a water use license.

Ensure that all construction vehicles are in good working order and that they are not emitting more exhaust fumes than necessary.

Trees and shrubbery must be used to reduce the Carbon Footprint of the site. Additional techniques that include recycling, use of solar power for geysers and lights must be introduced into the development to reduce the Carbon Footprint.

Control and limit the speed of vehicles driving along the gravel roads.

Discourage users and land owners from making use of coal ovens. Energy efficient electrical appliances should be encouraged to offer warmth in winter and for cooking purposes.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction			√		Low
Operation			√		Low

5.3.4 Risk to the Topographic Character (Elevated Buildings, Obstruction of View, Character)

Status Quo Conditions (i.e. relevant information)

The site lies vacant except for a few isolated homesteads that are each of single storey height. The most obvious topographic features of the site are the undulating hills and valleys with the associated watercourses.

The most distinctive anthropomorphic feature on the site is the 275KVA powerline that bisects the site from south east to north west.

Impact Assessment for the Development Phases

Construction
During the primary construction phase, the site will have to be levelled and prepared for the actual construction of the aboveground structures associated with the human settlement. These structures will largely include single storey dwellings. The proposed school will also be a single storey structure, although the height may exceed that of a residential unit. A small number of two (2) storey group housing structures that represent flats or apartments are envisaged near the road intersection in the north of the site. These will change the overall character of the site and impose a more urban form to the area.

The wetlands and watercourses that are present on site will be retained and form part of an "Open Space" area. This will provide fauna and flora with natural habitat as well as offer a natural backdrop to the human settlement. Similarly the ridge and koppie that form natural features of the site will also be retained as public open space.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Topographic Character	Region	Short	High	Likely	High	Medium

This impact is considered to be of Medium significance before mitigation.

Operational
The possible impacts on the topography during the operational phase include that of the height of the above ground structures compared to the structures of the surrounding areas.

The fact that the site does not occupy a high elevation in the general area means that it will not create difficulties in terms of visibility from far off. No landscape features surround the site that the Residential Township would hide.

The maximum height for the township is 2 storeys and this will preclude significant structures on site such as water reservoirs, significant electrical infrastructure or any other elevated structures.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Topographic Character	Region	Long	Medium	Unlikely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

The preparation of the site must be undertaken according to a plan/programme.

The architectural style and form of the building must integrate with the surrounding character for the area.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction		√		√	Medium
Operation			√		Low

5.3.5 Risk of Pollution/Contamination of Surface Water Resources

Status Quo Conditions (i.e. relevant information)

The site is bisected by a non-perennial watercourse that drains from north west to south east across the site. A farm dam and associated wetlands lie within the catchment of the watercourse. The site drains south east ward into the Onderbroekspruit. This watercourse & channel is deeply eroded and appears to flood seasonally and/or periodically. At most times of the year the watercourse is non-perennial and does not flow.

On the far west of the site occurs a well that lies on the periphery of the site and that will not be developed.

Impact Assessment for the Development Phases

Construction
The construction of relevant services such as roads & below ground services (water pipes, sewage pipes, electrical cables and ducting, etc.) will create areas of preferential surface flow and opportunity for erosion.

Storm water that flows across the site during the construction phase is highly likely to erode the excavated soil. This storm water is likely to carry silt and sediment into the stream channel and both reduce the water quality (owing to siltation) as well as the physical structure of the stream bed. Increased storm water flow (i.e. peak flows during storm events) is also highly likely to erode the stream bank and give rise to local flooding that could possibly impact on the usage of the main access roads and low water bridges.

Other important impacts on the surface water include the increased sediment in the road ways that are used to access the site. These need to be kept regularly clean to prevent silt from accumulating in storm water run-off.

For the above reasons, it is imperative that adequate storm water management measures (such as attenuation ponds, berms, swales and hay bayles be used to minimise the frequency and intensity of storm water run-off impacts on the construction site.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Surface Water Pollution	Site	Short	High	Likely	Medium High	Medium

This impact is considered to be of Medium High significance before mitigation.

Operational

The transformation of the development area into largely impermeable surfaces will significantly increase the peak flow of storm water run-off. This is because storm water will be prevented from entering the landscape and instead be concentrated to flow along roads, pipes and hard surfaces that increase the flow rate of the water. Consequently such water will have a greater degree of erosivity (erosion power) and thereby create erosion gullies. Increased erosion will also increase the silt load of run-off water and thereby increase the amount of sediment in the stream channels and water courses down slope of the site.

The proposed development must therefore include several attenuation dams / ponds to slow the speed of storm water run-off prior to discharge of the water into the stream channel.

The Civil OSR includes a strategy that will minimise the impact of storm water run-off by attenuating the water into ponds with protection of outlet structures with gabions, riffle beds and gabion mattresses.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Surface Water Pollution	Region	Long	Medium	Likely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

Ensure that adequate provision is made for storm water run-off. This must include the establishment of berms or swales during the construction phases along with the use of bayles of hay to prevent siltation, sedimentation and erosion of the stream channel.

An adequate number of attenuation ponds with erosion protection of the outlet structures is required during the operation phase.

Appropriate (i.e. monthly) monitoring of the river course and water quality is required during the full extent of the construction phase to track changes and impacts. This must include at least 3 sample points - Upstream (out of site), Midstream (on site) and Downstream (beyond site).

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction				√	Medium
Operation			√		Low

5.3.6 Loss of Wetland Habitat and Function

Status Quo Conditions (i.e. relevant information)

A hill slope seep is located on the upper western boundary of the site. A small non-perennial stream drains into this wetland that has historically be used as a farm dam. However the dam wall has eroded. Historically, a concrete track was located across the dam wall and used to access the old farm house. Parts of the wetland and old road/dam wall have eroded and generally the species richness of moderate to low. This is probably a result of the current impacts of grazing, the eroded characteristics of the stream channel and the historical impacts of farming.

Impact Assessment for the Development Phases

Construction
The excavating and removal of vegetation in the riparian zones should not be allowed. The watercourses in the study site do not have distinct riparian zones and the recommended buffer zones cover these areas well and act as essential buffers for protecting the integrity of the watercourses. Attention must be given to erosion along steeper gradients and stream banks.

Erosion of stream banks, especially along the steeper contours of the site is a real high potential negative impact. Erosion leads to gully formation (dongas) as well as siltation of watercourses, which are negative impacts that can be avoided during the construction phase and rectified through the rehabilitation programme.

The disturbance of soils, such as digging and excavating always has the real potential negative impact of causing erosion and washing of soils into streams and the dam. Hereby causing a negative increase in siltation.

Construction related activities that are likely to be undertaken prior to mitigation include the removal of top soil and disturbance of flora (vegetation) that will lead to the destruction of habitat and overall loss of biodiversity within the wetland features. Disturbances within the wetland features may lead to the loss of migratory routes for more mobile species. Furthermore, the removal of vegetation and the disturbance of soils will result in the alteration of the habitat and ecological structure.

Construction related activities may result in the loss of ecosystem services and function such a flood attenuation, sediment trapping, phosphate assimilation and toxicant assimilation ability. Impacts may further result in a decrease in the ability of the wetland to support biodiversity as a result of vegetation and general anthropogenic activities which will increase within the study area and surrounding areas. However, as the wetland features are not used directly for socio-cultural provision such as crop cultivation and water supply, this impact is considered to be moderately low.

Other important issues to be considered include the following potential construction impacts:

- Poor planning leading to placement of infrastructure within wetland areas and buffer zones;
- In appropriate design of infrastructure leading to modification to wetland areas;
- Site clearing and removal of vegetation leading to increased run off, erosion loss of ability to assimilate phosphate and intoxicants;
- Site clearing and the disturbance of soils leading to altered wetland habitat, inability to support biodiversity;
- Earthworks in the vicinity of the features leading to increased run off and erosion and altered run off patterns, loss of flood attenuation capacity;
- Spillage from construction vehicles leading to the contamination of the wetland soils, water quality deterioration;
- Changes to wetland community due to alien invasion resulting in altered wetland conditions;
- Disturbance of soils resulting in sediment deposition into the wetland areas during run off;
- Construction of stream crossings altering stream and baseflow patterns and water velocities.

The construction of relevant services such as roads & below ground services (water pipes, sewage pipes, electrical cables and ducting, etc.) will create areas of preferential surface flow and opportunity for erosion. Storm water that flows across the site during the construction phase is highly likely to erode the excavated soil. This storm water is likely to carry silt and sediment into the stream channel and both reduce the water quality (owing to siltation) as well as the physical structure of the stream bed. Increased storm water flow (i.e. peak flows during storm events) is also highly likely to erode the stream bank and give rise to local flooding that could possibly impact on the usage of roads.

Other important impacts on the surface water include the increased sediment in the road ways that are used to access the site. These need to be kept regularly clean to prevent silt from accumulating in storm water run-off.

For the above reasons, it is imperative that adequate storm water management measures (such as attenuation ponds, berms, swales and hay bayles be used to minimise the frequency and intensity of storm water run-off impacts on the construction site. The civil engineer has provided a preliminary design for the crossing of the wetland for the access road (**Appendix E6**) and this design takes into account requirements provided by the Wetland Ecologist in terms of mitigating impacts on wetland function.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Wetland Function	Local	Short	High	Likely	Medium High	Medium

This impact is considered to be of Medium High significance before mitigation.

Operational

The transformation of the development area into largely impermeable surfaces will significantly increase the peak flow of storm water run-off. This is because storm water will be prevented from entering the landscape and instead be concentrated to flow along roads, pipes and hard surfaces that increase the flow rate of the water. Consequently such water will have a greater degree of erosivity (erosion power of the water) and thereby create erosion gullies. Increased erosion will also increase the silt load of run-off water and thereby

increase the amount of sediment in the stream channels and water courses down slope of the site.

Operational activities such a possible driving through wetland areas will result in the deterioration of habitat. In addition, edge effects from the development will lead to the establishment of less desirable vegetation species (exotic or alien species).

Other important issues to be considered include the following potential operational impacts –

- Discharge of storm water leading to incision of soils and loss of vegetation cover within the wetland areas;
- Altered hydrology due to increased flow and concentration of run off;
  Inability to support biodiversity as a result of changes to water quality, increased sedimentation and altered natural hydrological regimes;
- Increased run off potential as a result of impermeable surfaces;
- Erosion and Sedimentation leading to loss of habitat as a result of On-Going disturbance of soils during general operational activities;
- Dumping of wastes within wetland areas;
- Indiscriminate driving through wetland areas leading to soil compaction;
- Inundation caused by inappropriate storm water drainage and flow;
- Inability to support biodiversity as a result of limited vegetation extent and introduction of alien plant species.

The proposed development must therefore include several attenuation dams / ponds to slow the speed of storm water run-off prior to discharge of the water into the stream channel.

The Civil OSR includes a strategy that will minimise the impact of storm water run-off by attenuating the water into ponds with protection of outlet structures with gabions, riffle beds and gabion mattresses to support the adjoining areas. These ponds will serve as silt traps, slow the flow of run off water and thereby mitigate the impact on the wetland.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Wetland Function	Site	Long	Medium	Likely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

Ensure that adequate provision is made for storm water run-off. This must include the establishment of berms or swales during the construction phases along with the use of bayles of hay to prevent siltation, sedimentation and erosion of the stream channel.

An adequate number of attenuation ponds with erosion protection of the outlet structures is required during the operation phase.

Appropriate (i.e. monthly) monitoring of the river course and water quality is required during the full extent of the construction phase to track changes and impacts. This must include at least 3 sample points - Upstream (out of site), Midstream (on site) and Downstream (beyond site).

All development footprint areas and areas affected by the development should remain as small as possible and should not encroach onto surrounding more sensitive wetland areas and associated buffer zones.

Any discharge of run off into the wetland area must be done in such a way as to prevent erosion.

All surrounding areas affected by construction should be rehabilitated upon completion of the construction phase.

Implement alien vegetation control within the system

As far as is possible, all construction activities should occur within the low flow season, during the drier winter months.

Any areas where active erosion is observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is re-instated to conditions which are as natural as possible.
Remove all alien and weed species in order to comply with existing legislation. Species specific and area specific eradication recommendations include –

- Taking care which herbicide is used to reduce latent and residual impacts on the wetland habitat
- Keep footprint areas as small as possible when removing alien plants
- Do not allow vehicles to drive through the wetland or drainage feature
- Dispose of removed alien plant materials at a registered waste disposal site.

Restrict all vehicles to designated roadways. The indiscriminate movement of vehicles through wetland/drainage areas must be strictly prohibited.

As much vegetation growth as possible should be promoted within the study area in order to protect soils. The use of indigenous vegetation species must be used where hydroseeding is implemented.

De-silt all wetland areas affected by construction activities.

During the construction phase, erosion berms should be installed to prevent gulley formation and siltation of the wetland. Berms should be spaced as follows –

- Where the track has a slope less than 2%, berms should be 50m apart
- Where the track has a slope between 2% and 10%, berms should be 25m apart
- Where the track has a slope between 10% and 15%, berms should be 20m apart
- Where the track has a slope greater than 15%, berms should be 10m apart

Reinforce banks and drainage features where necessary with gabions, reno mattresses and geotextiles but as far as possible, soft rehabilitation techniques should be employed.

The following general mitigating measures (along with those laid in sections above) are recommended to help reduce the negative impacts that the project might have on the natural environment. The implementation of recommended mitigating measures is necessary if the conclusions and assessments of the report are to remain pertinent.

Construction Phase

- No temporary accommodation or temporary storage sites to be erected within 100m of the any watercourse (including wetlands, drainage lines and dams).
- No excess imported soils or stone (if used during the construction phase) may be left behind. These materials to be removed on completion of the project.
- Disturbed surface areas in the construction phase to be rehabilitated. Only locally indigenous grasses to be used in the rehabilitation plan.
- All hazardous materials such as but not limited to paint, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the terrestrial and water environments.
- All construction material, equipment and any foreign objects brought into the area by contractors and staff to be removed immediately after completion of construction.
- Removal of all waste construction material to an approved waste disposal site.
- A site-specific storm water management plan is required.
- A site-specific rehabilitation plan of watercourses is required.
- Aquatic monitoring is required by an independent specialist during the construction phase of the project.

Maintenance Phase

- Mechanical control and monitoring of alien plants around disturbed areas to be implemented.
- No chemical control (herbicides) of alien plants to be used within 100m of any watercourses. Herbicides could get into the water system and will have a detrimental effect on the environment.
- Rehabilitated areas to be assessed and corrected where necessary.
- Potential erosion areas to be inspected and corrected or rehabilitated where necessary. Special attention must be given steep areas where erosion and gully formation can have direct impacts on the streams, dam and other watercourses in the study area.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction				√	Medium
Operation			√		Low

5.3.6 Loss of Agricultural Potential

Status Quo Conditions (i.e. relevant information)

The site has not formally been cultivated in the recent past following a survey of the aerial photos of the last 10 years. Historically the site was used as grazing land.

The agricultural potential of the site is Low to Moderate owing to the shallow soil profile and prevalence of rocks especially in the elevated portions of the site that form the watershed.

Parts of the site and around the old farm house were historically terraced and probably used for crop production. This area is today infested with Eucalpytus trees and black wattle and offers not value as agricultural land.

Impact Assessment for the Development Phases

Construction
The site has historically been used to cultivate pasture grasses for cattle feed and is generally regarded to be economically unviable to commercially farm for agricultural production.

The establishment of the human settlement will transform a large section of the site and this will lead to be the loss of some of the top soil on the site. It is therefore imperative that measures be used to minimise the loss of top soil by removing and stockpiling the top 0.3m of top soil for later use in landscaping or site development.

The development of the site will lead to the loss of the agricultural potential of the site and this may have a negative impact on the agricultural production of the Province KwaZulu Natal. It is important to note that the site has historically been used to cultivate pasture grasses for cattle feed and has never been used for the cultivation of crops. Hence, it's current contribution to agricultural production in the Province is regarded to be relatively small and insignificant. The many contributing factors that increase costs to operate the site further ensure that the site is not commercially nor economically viable.

This loss of agricultural potential also needs to be weighed up against the significant social, economic and infrastructure benefits that the project will offer to the local economy, surrounding areas and Province of Kwazulu Natal. The direct and indirect income from the development of the project site as well as stimulus of the development potential of the broader area by means of rates, taxes, infrastructure development and development opportunity stands to far exceed the returns that may be derived (at great cost) by agricultural development. The envisaged development of the site is further earmarked in the RSDF and spatial planning of Roosboom. The development would further assist in the sustainable use and development of infrastructure that inevitably results in the site being better used for residential development than agricultural opportunities.

Whenever construction takes place on a site there is a possibility of soil contamination. This would occur as a result of oil/fuel leaks from construction vehicles and machinery. In order for the soil to be significantly contaminated, large quantities of fuel or oil must seep into the soil. The possibility of this impact occurring is also limited to the primary construction period at large.

With the proper precautionary measures in place it is unlikely that soil contamination will occur on the site and therefore the proposed development is not likely to have any detrimental impacts on the soil of the site.

Another possible impact that might occur during the construction phase is that of soil erosion. Construction activities will loosen the soil and this will wash away during intense rainstorms

and with storm water run-off. Topsoil that has been removed from the building sites should also be stored upslope so that runoff waters do not erode it away. Such stockpiles must be protected from soil loss by means of constructing berms, using bricks or soil bags or hay bayles to minimize wash away during storm events.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Agricultural Land	Site	Long	Low	Definite	Low	None

This impact is considered to be of Medium significance before mitigation.

Operational
It is not foreseen that any detrimental impacts should occur once the Residential Township is operational, and the likelihood of impacts on the soil occurring is eliminated to a large degree as opposed to the primary construction phase. These impacts may include pollution of the surrounding site and areas by litter, rubbish, dumping and the like.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Agricultural Land	Site	Long	Low	Likely	Low	None

This impact is considered to be of Low significance before mitigation.

Recommended Mitigation Measures

Ensure preservation of the top soil by creating top soil stockpiles in disturbed zones.

Areas scheduled for construction should be cleared only 1 week prior to construction.

Ensure that storm water can-not erode the top soil stockpiles and construct and maintain a berm around the top soil stockpiles at all times.

Prevent pollution of the surrounding soil by litter, run-off, spills and dumping of waste.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction		√			None
Operation		√			None

5.3.7 Loss of Faunal species and/or Faunal Habitats

Status Quo Conditions (i.e. relevant information)

The site and general area supports only more common faunal species. No rare or red listed faunal species have been recorded on the site.

A limited & restricted diversity of birds, small mammals, herpotofauna and insects occupy the land probably as a result of the cultivation of pasture grasses as well as the regular disturbance caused by human activity on the site and in proximity to the site.

An ecological assessment of the site recorded a low diversity of habitat types and therefore the diversity and abundance of faunal species was found to be average to low and comparable with similar urban areas.

Impact Assessment for the Development Phases

Construction
The proposed change of land use will permanently change the present landscape and result in the displacement of the existing faunal populations including invertebrates and other living organisms. Furthermore, faunal species making use of the site are likely to be disturbed by the increase in human activity associated with construction activities.

Secondary impacts include the generation of noise and dust, which may displace faunal species. Some of the smaller species that use the soil as their habitat might not escape during construction activities. These may be destroyed.

Due to the fact that the wetlands present on the development site will form part of the open space area and that attenuation ponds will be constructed, the possibility that various species might return to the site once the development is in the operational phase is greatly enhanced.

The habitats on site was generally of poor quality with some islands of wetlands scattered through the site. The site in total was found to be poor in habitat diversity and subsequently poor in species richness. While it is still possible that scarcer species such as the Grass Owl may visit the site and hunt over the area, the pedestrian movement on the site as well as altered state of the habitat and limited shelter, was not found to be conducive for scarcer species, which are often also more sensitive to disturbance.

The bat species present in the area will not be negatively affected, and may even benefit from increased lights that will attract more insects, if their natural rest habitats like trees and mine adits are not disturbed. Such habitats were not observed on site.

The available habitat was not considered suitable for use by any threatened reptiles or amphibians.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Fauna species & habitat	Site	Short	Low	Unlikely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Operational
The impact of the development on the fauna will take place during the primary construction phase. Once the development is in operation, the impacts would already have occurred and

therefore the operational phase is not foreseen to have any detrimental impacts on the fauna of the site and surrounding area.

The proposed development however also includes steps that will be taken to improve the current state of the wetlands on site. This will include the development of an ecological management plan that will eliminate exotic species, the re-introduction of local endemic species, the restriction of activities on the site as well as the formalization of movement on and across the site. These steps will undoubtedly improve the habitat conditions for fauna that may have historically used the site.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Fauna species & habitat	Site	Long	Low	Unlikely	Medium	Low

This impact is considered to be of Low significance before mitigation.

Recommended Mitigation Measures

Inform contractor's workers that animals should not be harmed during construction.

The fences of the development must allow free movement of small wild animals.

The hunting of birds or any other animal shall be prohibited.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction			√		Low
Operation			√		Low

5.3.8 Loss of Floral Species & Ecological Habitat

Status Quo Conditions (i.e. relevant information)

The vegetation on site is largely indigenous vegetation and comprises six (6) vegetation units.

No red list species were observed to occur in the natural grassland that is connected with the large areas by means of the non-perennial stream.

The development footprint will result in the loss of approximately 48ha of indigenous vegetation, some of which has been historically transformed by cattle grazing, terraces and the establishment of eucalyptus and black wattle plants. More than 27ha of the site will be retained as open spaces that include water courses, wetlands and ecologically sensitive areas. Approximately 6ha of the site has historically been cleared by existing developments (residential encroachment areas).

Impact Assessment for the Development Phases

Construction

The impact that will affect the ecology most, is the clearing of land for houses and services. The clearing of vegetation will lead to the loss of grassland, rocky outcrop and stream vegetation. The loss of habitats will lead to the loss of floral and faunal species diversity. The vegetation that could be lost is Kwazulu-Natal Highveld Thornveld. Mitigating factors are that this vegetation type has a conservation status of Least Threatened. It is also not listed as an Endangered Ecosystem in terms of the NEMBA.

The natural grassland habitats were found to support a moderate species richness. Signs of overgrazing were observed and it is expected that the habitat has been affected by veldfires. No habitat for scarce floral species were observed and limited signs of faunal species occurred. The impact on this area is therefore not considered to be a Red flag for development.

The rocky areas (Central Rocky Ridge grassland and Rocky Woodland) however provide habitat and variety of plant species that is different and more varied than the natural grassland. Woody elements are also present in these areas providing additional habitat for birds and tree living faunal species. Regarding sensitive floral species, the rocky habitat provides some habitat for scarce faunal and floral species such as rock scorpions and the plant *Bowiea volubilis*. To reduce the risk of losing this habitat, the rocky habitats should be conserved in the layout of the township. The rocky areas can further be protected by creating a 15 meter buffer around the areas to limit the impacts of development on the vegetation.

The streams have hydrological function ensuring that water is drained off the site and away from houses. Streams further act as a water source for all faunal species of the area needing water and also provides a safe movement corridor for faunal species. The loss of, or impact on the streams and wetland will negatively affect the ecology of the area. These areas should also be left free from development with protective buffer zones as per the wetland report.

The potential impact on the Disturbed grassland patches lower down on the slopes towards the Onderbroekspruit, was found to have been altered by grazing, farming and erosion. The impact on these areas will have a Low ecological significance.

No birds species of concern were listed for the area. The open spaces within the layout plan as well as on surrounding land, will allow for grassland species to continue to occur in the area or disperse into surrounding land.

The clearing of vegetation can lead to erosion, when rainfall flows over bare soil. The sediments can land in the streams and negatively affect the ecosystems that are functioning here. For this reason, the construction of the township and services should be done systematically without encroaching on streams and without clearing large areas of vegetation if construction is not immediately eminent in such areas.

The proposed township may isolate natural areas from other areas and subsequently affect the connectivity of habitats. This will affect the movement of species and may specifically impact on smaller faunal species that cannot move long distances or fast enough to move out of the area of impact. The creation of open spaces or areas where no development occurs, within the development site, will mitigate this impact and allow for continued connectivity through the development site. Sensitive areas have been allocated for this purpose and should stay free from development.

The construction vehicles and activities on site may generate its own set of impacts. These may include increased litter and plastic, disturbance of soil where exotic vegetation may invade, trapping of small faunal species in open trenches, oil and diesel spillages on soil or near streams, informal vehicle crossing of streams causing erosion and siltation in the stream and disturbance of allocated non-development areas. Secondary impacts include the generation of noise and dust, which may displace faunal species.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of floral species & habitat	Site	Short	High	Definite	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Operational

The main impacts on the flora of the proposed development site would already have occurred by the time that the development is in its operational phase. Therefore it is not envisaged that the operational phase will have any detrimental impacts on the flora of the site and surrounding area.

During the operational phase of the facility, the increased people activity may increase litter blowing into the surrounding land. In addition, storm water running off the site, mixed with oil and fuel can act as a contaminating factor to the streams. Inhabitants of the township may start invading areas set aside for non-development, such as the rocky areas and stream buffer areas. Disturbed soil may lead to an increase in exotic plant establishment (i.e. infestation). Harvesting of natural resources in allocated non-development areas may further occur.

More than 35% of the site will be used for open space including buffers, streams and wetlands. These sites will offer key decolonization opportunities for local endemic flora species as well as likely Red Data species. This will undoubtedly enhance the ecological integrity of the site and increase its resilience to impacts such as edge effects, pollution, erosion and flooding.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of flora species & habitat	Site	Long	Medium	Likely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

Obtain permission from the ECO to proceed with the clearing of vegetation from the development area.

Utilise the method for vegetation clearing most appropriate for the environment.

Use mechanical methods rather that chemical methods wherever possible to remove exotics and aliens.

Identify and mark trees or other vegetation that should be protected and that should not be removed during construction.

Retain natural trees, shrubbery and grass species wherever possible.

Hydroseed disturbed areas with a natural mix if indigenous grass species.

Loss of habitat/eco-systems

- Wetland areas should be maintained and development encroachment should be limited during construction and operational spaces. These features could provide for open spaces in an increasing urbanized area and simultaneously assist with floodwater retention;
- Proper fencing should be erected around wetland to limit damage to the stream structure;
- Fencing should be maintained regularly;
- Construction traffic should not be allowed to cross smaller wetland areas on an ad hoc basis. Specific routes should be allocated and demarcated.

Loss of surrounding habitat and sensitive species

- The footprint of the construction activities must be retained within the study area. Overspill of construction activities into the adjacent land must be avoided.
- The location of the population of *Bonatea speciosa* orchids must be assessed against the construction activities of the access road to determine the potential impact. Preferably the population must be protected *in situ.*
- Should the population be protected *in situ* detailed measure should be agreed with the contractor to exclude disturbance in this area. Alternatively, the necessary steps must be taken to obtain approval for the removal of plants to a safer location.
- The developer must ensure that only demarcated areas are utilised as access routes and that there is no uncontrolled construction traffic on surrounding land. Access roads must be constructed with consideration to minimisation of erosion and should accommodate natural water flow over the area;
- Complete fencing must not be erected around the entire site at once, but rather be done in sections to allow animals opportunity to escape;
- Solid wall fences should be limited and/or rather include sections of palisade fencing to allow for the movement of small faunal species in and out of the site especially where the open space area and/or wetlands borders the property.
- Where access routes to the property cross any water courses, these crossings must be upgraded and the impacts of heavy vehicles moving through this area anticipated and mitigated prior to development.
- Construction activities should commence at low intensity to discourage animals from utilising the site and allow animals within the site time to disperse during the initial stages. Initial activities should start in one section of the site and gradually extend across.
- Should any fauna be encountered on site during development, they must be carefully relocated into the neighbouring natural grassland area.

Mitigation Measures for the Construction Phase

- High impact construction areas must be fenced off to prevent widespread impacts;
- Topsoil must be conserved in an appropriate manner;
- Exotic invasive floral species (excluding some tall trees) on the site should be removed;
- Only indigenous floral species should be used during the landscaping of the site;
- Before construction starts, construction workers should be educated with regards to littering, ad hoc veld fires and dumping;
- A sufficient number of chemical toilets must be situated in appropriate places to prevent pollution of the study site;
- All waste materials should be removed from the site once construction has been completed and disposed of appropriately at a landfill facility;
- The ignition of fires should be avoided unless in specified places for cooking purposes and no solid waste material should be burnt on the site;
- The substrate should be protected to avoid soil erosion;
- Only land to be used for services infrastructure should be scraped to mitigate dust pollution in the area;
- The capture or hunting of any fauna on the site is not permitted as it is unlawful.

Access road mitigation measures

- The road reserve that will be affected should be demarcated to assess where sensitive vegetation will be affected;
- Construction sites should be placed away from wetland areas;
- Construction vehicles may not be washed in wetland areas;
- Sensitive vegetation must be demarcated with a three strand wire fence and such limitations communicated to the contractor;
- Dust suppression must be applied in the wetland area if the dirt road is used for access to the site;
- Construction activities must not lead to the movement of waste material into the wetland.

Specific Measures from specialist

- The west east running rocky outcrop as well as the rocky habitat in the western corner of the site must be allocated as open space where construction activities should actively be prevented and limited;
- These areas should be demarcated to prevent construction vehicles in this area;
- The stream areas with associated buffer areas as well as existing eroded areas on the lower ends of the site should be kept free from development. This will allow not only for natural habitats, including grasslands, to stay intact, but also to protect these areas against impacts and further degradation;
- Trenches cut for services, may not be left open over holiday periods to prevent small fauna to get trapped in there;
- The construction site must be screened for exotic invasive species on a regular basis, and such species appropriately removed if they appear;
- No heavy vehicles may cross stream areas without the necessary protective or formal structures in place;
- Noise and dust must be mitigated to limited such impact on the fauna and flora of the area;
- Open space areas may not be used for storage of construction material. Signage should be brought into these areas to indicate the purpose and nature of the open land;
- Landscaping efforts must aim to increase indigenous species on site, which will require

less water than exotic trees and subsequently less maintenance once established;
- Should any fauna be encountered on site during development, they must be appropriately relocated into the neighbouring natural areas. Species that could be encountered include snakes and hedgehogs;
- Before construction starts, construction workers should be educated with regards to littering, animal trapping and veld fire prevention;
- Both the construction and the operational phases must include waste and litter management strategies to prevent impacts on the stream ecology and surrounding land in general;
- Both the construction and the operational phases must include storm water management strategies that address potential impacts on the site and stream ecology;
- An effluent and/or contaminated storm water management plan must be devised for the site can include e.g. an oil/water separator, to ensure that runoff water does not pollute the streams;
- During the operational phase, the open spaces must be demarcated and information signage provided to indicate the value and purpose of these areas.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction			√		Low
Operation			√		Low

5.3.9 Social and Cultural Features (Crime, Community Safety, Sense of Place)

Status Quo Conditions (i.e. relevant information)

The site for the proposed development of the Human Settlement is located in proximity to a number of social and cultural facilities that include 2 schools & churches. The site is readily accessible by car and public transport. Currently no social activities take place on the site other than the informal local soccer field. No formal structure or infrastructure occurs on the site.

Impact Assessment for the Development Phases

Construction
The construction phase of the development is envisaged to have an impact on the social and cultural features of the area. These impacts are not necessarily all negative.

Noise pollution is expected to be generated by the associated activities of the construction phase. As in the case of any construction process, the visual appeal of the sight might be affected for the duration of the construction phase and might lead to complaints by surrounding landowners.

Additional impacts on the social and cultural features of the area due to the construction of the development include that of traffic, safety and security, property value and sense of place. An increase in traffic congestion is a possibility due to construction vehicles entering and leaving the site. Safety and security is always a concern when construction activities are taking place on a site. Measures need to be taken in order to ensure the safety of the construction staff as well as the public on site. The possibility of the development site being targeted by crime exists, and appropriate security measures must be put in place.

It is not envisaged that the value of the property will be impacted negatively during the construction phase of the development, in contrast it is likely that land value for the site and surrounding area will increase substantially.

The sense of place is likely to be affected by construction activities. This will include additional traffic, congestion, dust and noise and the removal of the vegetation across the site.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Community Safety	Region	Short	Moderate	Likely	Medium High	Low

This impact is considered to be of Medium High significance before mitigation.

Operational

A limited level of noise pollution originating from an increase in vehicular traffic is foreseen once the proposed development is in operation. The value of the property will most likely be impacted upon in a positive sense. The surrounding residents of Roosboom are not foreseen to experience any nuisance noise originating from the development once it is operational. This is owing to the fact that the proposed development is located approximately 200m to the South of Roosboom as well as the nature of the proposed development.

The possibility of an increase in traffic congestion cannot be excluded. A detailed traffic impact study has been conducted and the appropriate measures will be taken to ensure that the development will have the smallest possible impact on the traffic of the surrounding area. It is not foreseen that the development will have any detrimental impacts on the sense of place once the development is operational. The areas surrounding the site can be characterised by industrial as well as residential land uses.

If the necessary security measures be put in place once the development is in operation, then it is not foreseen that crime will be an issue to the site and its surrounds.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Community Safety	Region	Long	Moderate	Likely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

Limit construction time to the following hours: 06:00 to 18:00 during the week and 07:00 to 15:00 on Saturdays, and no noisy activities on Sundays.

Ensure that the visual aspects of construction are taken into consideration to lessen impacts on residential and commercial amenities in the area.

Screen construction areas with shade cloth or other suitable material from adjacent properties.

All contractors must take cognisance of and abide by the Occupational Health and Safety Act (1993).

Introduce greenery, tall trees and landscaped walkways in the development. This will increase the sense of place and make the development easier on the eye. Landscaping will further reduce noise impacts, glare and heat.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction			√		Low
Operation			√		Low

5.3.10 Loss of Cultural Historic and Archaeological features

Status Quo Conditions (i.e. relevant information)

A number of cultural historic resources occur on the site. These include a historical cemetery, old farmstead that has been demolished over time and several graves.

Impact Assessment for the Development Phases

Construction
It is assumed that the pre-construction phase involves the removal of topsoil and vegetation as well as the establishment of infrastructure needed for the construction phase. These activities can have a negative and irreversible impact on heritage sites. Impacts include destruction or partial destruction of non-renewable heritage resources. During the construction phase, the impacts and effects are similar in nature but more extensive than the pre-construction phase. These activities can have a negative and irreversible impact on heritage sites. Impacts include destruction or partial destruction of non-renewable heritage resources.

The amended layout will not directly impact on the known cultural historic features on the site. For the features that are rated with a medium to low significance, a Phase 2 cultural historic assessment will need to be undertaken and an application for a destruction permit obtained prior to development commencing on site.

It is also likely that staff and/or employees could deface and/or destroy the cultural historic features by means of collecting artefacts and/or excavating features. This will require preventative steps during the construction period.

The possibility always remains that graves might be discovered during construction activities. Should this be the case, the area must be demarcated and construction stopped immediately and a specialist should be called in to assess the findings.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Cultural Resources	Site	Short	High	Improbable	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Operational
The graves and cemetery as well as any other cultural historic feature of the site will need to be protected from people that may seek to deface these features and/or remove historic artefacts. Therefore these areas will need protection in the form of fencing and relevant notices to ensure visitors and the public are aware of the significance of these items.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Cultural Resources	Site	Long	High	Unlikely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

Construction must be stopped and a professional archaeologist consulted should any archaeological remains be uncovered.

- Confirmation of grave sites in the study area through a social consultation process that addresses the issue of unmarked graves associated with structures as well as stone cairns currently interpreted as possible graves;
- Graves located in future and known graves should ideally be retained *in situ* in open spaces;
- Implementation of a chance find procedure for the project as outlined below;
- A Site development plan should be compiled for the development;
- Site specific recommendations should also be adhered to

Chance Find Procedure for Heritage resources

The possibility of the occurrence of subsurface finds cannot be excluded. Therefore, if during construction any possible finds such as stone tool scatters, artefacts or bone and fossil remains are made, the operations must be stopped and a qualified archaeologist must be contacted for an assessment of the find and therefor chance find procedures should be put in place as part of the EMP. A short summary of chance find procedures is discussed below.

This procedure applies to the developer's permanent employees, its subsidiaries, contractors and subcontractors, and service providers. The aim of this procedure is to establish monitoring and reporting procedures to ensure compliance with this policy and its associated procedures. Construction crews must be properly inducted to ensure they are fully aware of the procedures regarding chance finds as discussed below.

- If during the pre-construction phase, construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage

site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager.

- It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find, and confirm the extent of the work stoppage in that area.
- The senior on-site Manager will inform the ECO of the chance find and its immediate impact on operations. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.

Chance find Procedure for Fossils

Monitoring Programme for Palaeontology – to commence once the excavations for foundations, water and sewage pipes, electricity supply poles or roads begin.

1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, wood, bone, coal) should be put aside in a suitably protected place. This way the building activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones. This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer/engineers then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then the site inspections by the palaeontologist will not be necessary. Annual reports by the palaeontologist must be sent to SAHRA.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction			√		Low
Operation			√		Low

5.3.11 Loss of Sense of Place, Land Use Character or Amenity

Status Quo Conditions (i.e. relevant information)

Currently the site is vacant except for a few isolated houses. The site comprises an indigenous grassland with watercourses and a rocky ridge. Adjoining areas comprise a peri-

urban / rural residential character of subsistence agriculture and related land uses. A school is located south of the site and a school also is found in Roosboom in the north. This area is more developed and typically peri-urban to urban in character.

The majority of land use in the area is residential with few formal trades or businesses in proximity to the site.

The Colenso/Ladysmith main road lies immediately east of the site and serves as a main transport link as well as activity spine.

Impact Assessment for the Development Phases

Construction
Certain aspects of the construction phase might impact on the surrounding land uses. Noise levels due to construction activities can give rise to complaints from the Roosboom Residential Township area to the east of the site. Another impact arising from the construction phase that might have an influence on the residential area is dust generation. This will have to be mitigated in an according manner.

It is not envisaged that the construction activities will have any detrimental impacts on the rural and peri-urban character surrounding the site.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Character	Site	Short	Medium	Likely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Operational
It is not foreseen that the operational phase of the proposed development will have any detrimental impacts on the environment. The reason for this being that the proposed land use of the development is of a similar nature than that of the surrounding land uses of the area.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Loss of Character	Site	Long	Low	Unlikely	Low	None

This impact is considered to be of Low significance before mitigation.

Recommended Mitigation Measures

Limit construction time to the following hours: 06:00 to 18:00 during the week and 07:00 to 15:00 on Saturdays, and no noisy activities on Sundays.

Ensure that the visual aspects of construction are taken into consideration to lessen impacts on residential, commercial and social amenities in the area.

Wet all exposed sand areas such as roadways, stockpiles and working areas that give rise to dust during the movement of construction vehicles as well as windy conditions.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction			√		Low
Operation		√			None

5.3.12 Cumulative Impacts

Status Quo Conditions (i.e. relevant information)

Currently the site lies largely vacant and is only used informally to graze cattle and as a soccer field. Occasionally and in the past, parts of the site have been occupied for housing when the adjoining township to the east was developed. The greatest current impact on the environment of the site is the use of informal pit latrines. These have influenced negatively the current quality of the ground water in proximity to these areas. Similarly and because the site is not managed and or maintained, several areas on the site are exposed to environmental risks that include unstable stream banks, uncontrolled storm water run off and eroded areas. Additional impacts also include the gradual expansion of the Eucalyptus and Black wattle tree populations across the site.

Impact Assessment for the Development Phases

Construction
The cumulative impacts of the construction phase of the development include that of pollution and sense of place. Impacts such as air pollution, noise, water quality, litter and waste generation all contribute toward pollution. The dust created during the construction phase is a form of pollution, as well as the noise from the construction machinery and vehicles. The deterioration of the water quality as a result of the construction activities is also a form of pollution. The waste/ litter that are being produced during the construction phase must also be mitigated as this leads to pollution of the site.

The impact on the sense of place is more relevant to the operational phase as opposed to the construction phase.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Cumulative	Site	Short	Medium	Likely	Medium High	Medium Low

This impact is considered to be of Medium High significance before mitigation.

Operational
There is a possibility that the sense of place can be affected by cumulative impacts of the operational phase of the development. This will be due to factors such as traffic, light pollution and security. An increase in traffic congestion in the area due to the development will lead to a people having a negative connotation to the sense of place of the area. A traffic impact study has been conducted in order to determine the impacts that the development will have on the area and to minimise these impacts.

Other factors such as flood lights burning throughout the night and crime due to the development may again lead to negative connotations regarding sense of place of the area.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Cumulative	Site	Long	Moderate	Unlikely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

Wet all exposed sand areas such as roadways, stockpiles and working areas that give rise to dust during the movement of construction vehicles as well as windy conditions.

All fuel tanks must be bunded to 150% of the capacity of the tank in order to contain any spillages that might take place.

Ensure that all construction vehicles are in good working order and that they are not emitting more exhaust fumes than necessary.

Limit construction time to the following hours: 06:00 to 18:00 during the week and 07:00 to 15:00 on Saturdays, and no noisy activities on Sundays.

Ensure that all floodlights are facing at a downward angle in order to prevent light pollution.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction				√	Medium
Operation			√		Low

5.3.13 Decommissioning & Latent impacts

Status Quo Conditions (i.e. relevant information)

Decommissioning & latent impacts would include activities associated with the removal of the contractors camp and associated impacts that remain following the construction phase.

No decommissioning impacts are foreseen for the proposed township as this will remain in place for perpetuity. However latent impacts may arise in cases where inadequate mitigation measures have been implemented and/or in cases where the recommended mitigation measure is ineffective.

Impact Assessment for the Development Phases

Construction
It is not foreseen that any latent impacts will occur due to the proposed development if the necessary mitigation measures are implemented during the construction phase.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Latent	Site	Short	Low	Unlikely	Low	None

Pollution						

This impact is considered to be of Low significance before mitigation.

Operational
The proposed development will not be decommissioned within the next 50/60 years and therefore no impacts associated with the decommissioning phase are likely. Latent impacts however likely during the operational phases where mitigation measures are not adequately implemented and/or enforced. Such impacts could possibly include the deterioration of the ground water quality should the VIP Laterine's not be regularly serviced with Bioenzmes, should waste including litter not regularly be collected, should land owners not comply with relevant by laws and requirements that may give rise to the destruction of the open spaces (i.e. collecting wood or other materials), dumping materials within the open spaces, discharging effluent in to the road or into the water courses, removing building materials form the river courses and/or wetlands, regularly lighting fires or trapping wild life, etc.

					Significance	
Impact	**Extent**	**Duration**	**Intensity**	**Probability**	**Pre Mitigation**	**Post Mitigation**
Latent Pollution	Site	Long	Low	Unlikely	Medium	Low

This impact is considered to be of Medium significance before mitigation.

Recommended Mitigation Measures

Latent impacts must be minimized and prevented by means of the following –

- Clear all work areas, construction areas and any other area that has been affected by any form of waste that has been deposited;
- Rehabilitate such areas by removing any contaminated soil and/or remediating the soil with appropriate micro-organisms;
- Hydroseed all cleared areas, unstable areas and sites that may have been rehabilitated;
- Any water source, natural areas or open spaces that has been contaminated, silted or invaded by exotic plants during the construction phase must be rehabilitated, managed and controlled annually to rehabilitate & stabilize the relevant areas;
- Informing residents by means of the local government structures not to exploit the open spaces and environmental features on the site. It will be necessary to ensure that residents are made aware of the ecological, cultural historic and wetland sensitivity of the site to circumvent such environmental impacts.

Impact Summary Matrix

	Significance of the Impact				
Phase	**None**	**Low**	**Medium**	**High**	**With Mitigation**
Construction		√			None
Operation			√		Low

5.4 Summary of specialist findings and recommendations

Specialist investigations included the following studies:

5.4.1 Town Planning Motivation

The Roosboom Housing Project is identified in the Alfred Duma Municipality's Integrated Development Plan (IDP). The IDP, as a key strategic overall guiding framework of the municipality, identifies a need to facilitate the provision of adequate housing to all deserving citizens. Therefore, the proposed development can be seen as way of giving effect to one of the municipality's key strategic and long terms objectives. The proposed development forms part of the municipality's mission to ameliorate the standards of living within its area of jurisdiction by providing housing and basic service needs.

The municipality is cognizant of the fact that it has to provide housing that is sustainable and promotes easy access to opportunities. This is further emphasised in the municipality's RSDF.

The municipality's Spatial Development Framework (SDF) identifies the Roosboom area as one of the areas that require housing interventions within the municipality.

The project area falls within the broadest development vision of the municipality with regards to ensuring and facilitating the development of sustainable human settlements.

The SDF identifies Roosboom as a tertiary node within the municipality. This essentially locates the project area within the broader sphere of influence within the municipality.

5.4.2 Cultural Historic Assessment

The study area was assessed both on desktop level and by a field survey. The field survey was conducted as a non-intrusive pedestrian survey to cover the extent of the study area as the development lay out was not available at the time of the survey. The proposed development is envisaged to comprise 1000 residential units as well as subsidiary land uses that include creches, primary school, religious centres and business. The township will also include Public Open Space areas and Public Roads on an area measuring approximately 83 hectares.

The background study highlighted that the general area under investigation has a wealth of heritage sites dating from the Stone Age to the recent past (e.g.,Vinnicombe, 1976, Klein 1977, Huffman 2007, Anderson 2015 a and b). During the survey of the study area, several features were recorded.

Key findings of the study are:

- Demolished ruins of several structures were recorded. The structures' potential to contribute to aesthetic, historic, scientific and social aspects are low, but sites like these are known to contain unmarked graves, usually of stillborn babies. In which case the sites would be of high social significance;
- Two isolated find spots were recorded consisting of a broken lower grinder and an undecorated ceramic sherd. No other features were found in associated and these features are therefor of no heritage significance;

- An independent paleontological assessment was conducted by Prof Marion Bamford (2019) that concluded as far as the palaeontology is concerned the project can proceed based on the implementation of a fossil chance finds procedure (Bamford 2019);
- A number of locations were identified across the survey area interpreted as grave sites. Some of these features are only marked by stone packed cairns and the possibility exists that not all of these could be graves but is handled as such until it is proven otherwise;
- The area is characterised by informal grazing and rural township developments. The proposed development will not impact negatively on significant cultural landscapes or viewscapes as the development is in line with the surrounding land use. During the Public Participation process conducted for this project, no heritage concerns were raised.

The proposed project will impact directly on heritage resources with the highest impact being on grave sites. Three alternative lay outs were assessed and if the recommendations in this report are adhered to all the alternatives are acceptable from a heritage point view with the Draft Final lay out being the preferred option.

To mitigate the impact of the proposed project on the recorded heritage resources the following recommendations apply as a condition of authorisation (part of the EMPr) and based on approval from AMAFA.

- Confirmation of grave sites in the study area through a social consultation process that addresses the issue of unmarked graves associated with structures as well as stone cairns currently interpreted as possible graves;
- Graves located in future and known graves should ideally be retained *in situ* in open spaces;
- Implementation of a chance find procedure for the project as outlined;
- A Site development plan should be compiled for the development;
- Site specific recommendations should also be adhered to as listed in the EMPr.

5.4.3 Ecological Assessment

The proposed new Roosboom township is located in close proximity to other townships, but is still mostly rural in nature. Subsequently the natural elements present, should be considered and protected within the township layout where possible and practical.

The area where the township site is located consists of natural land and supports a variety of natural fauna and flora. The area is however not highlighted as a high priority conservation area, neither as an area where there is a major concern for sensitive natural species which can be impacted upon. The assessment of the site indicated that sensitive species, should they be present, would more likely be associated with the rocky areas than the grassland areas.

Subsequently it is advised that the rocky areas as well as the stream areas be excluded as development areas, as these habitats will allow for continued use of the site by faunal and floral species presently making use of the site for the habitat and food requirements.

The value of the open land/open spaces for humans and nature will have to be conveyed to future residents to ensure the sustainable use of these areas. This can be done through simple signage or environmental education through nearby schools and community centres.

In summary, there are no ecological aspects that would render the site unsuitable for

development, if the more sensitive habitats are left undeveloped and protected within the site layout plan.

5.4.4 Wetland Delineation & Assessment

The conclusions and recommendations arising from the study are as follows:

- There are a number of watercourses on site, including semi-perennial streams and drainage lines, all of which were delineated.
- The main watercourse is the Onderbroekspruit, which flows from west to east in the southern area of the study site.
- All watercourses are viewed as having a sensitivity rating of 'high sensitivity'.
- The township development will have an impact on the inflow, interflow and recharge of the watercourses in the study area. The increase in hard surfaces, impediments (houses, roads, etc.) will have a big impact on the present natural flow and movement of water through the study site and larger system, particularly in terms of surface storm water flow and shallow sub-surface drainage and movement.
- Erosion and gully formation is a major problem in the region and study site and must be prioritized during planning and construction.
- The PES and EIS of the watercourses on site are calculated as follows:
    - Onderbroekspruit: PES – D (Largely modified); EIS – B (High).
    - Other small tributary streams: PES – C (Moderately modified); EIS – B (High).
    - Wetlands: PES – C (Moderately modified); EIS – C (Moderate)
    - Drainage Lines: PES – D (Largely modified); EIS – D (Low).
- The most sensitive area in terms of potential negative impacts on the water environment is the semi-perennial stream flowing north to south down the middle of the site and into the Onderbroekspruit.
- Aquatic monitoring of all watercourses is required during the construction phase.
- A water use licence application (WULA) process is required for the project, as there is construction through watercourses (in the top north of the site) and within 500m of wetlands.
- Buffer zones (no-go areas) have been recommended around the watercourses.
- A 50m buffer zone (no-go area) has been recommended around the Onderbroekspruit, as it is the major water arterial through the area, while narrower 32m buffers have been recommended around the smaller, less significant watercourses.
- No development may take place within the recommended buffer zones, with the exception of very limited recreational structures for public open spaces.
- It is recommended that locally indigenous thorntrees be planted along some of the streams, in open public spaces and in areas with high erosion potential.
- A site-specific rehabilitation plan for all watercourses is required.
- A site-specific storm water management plan is required. The plan must address outflow points into watercourses (velocity, erosion, etc.). Furthermore, outflow must be spread along the length of watercourses and must not simply be concentrated and released at one point at the lowest downstream area. In other words, flow of water into the entire length of watercourses must be addressed and managed to maintain the integrity of the watercourses.
- There are no fatal flaws and the project may proceed, but only with the implementation of recommended mitigating and management measures.
- It is opinion of the wetland specialist that the proposed project (activity) and related activities should be authorised. However, all watercourses should be avoided and all recommended mitigating measures must be implemented and form part of the EMPr.

5.4.5 Traffic Assessment

Based on assessment of the existing and planned future major road network, traffic counts, a traffic analysis and capacity analysis of road links in the study area, the following concluding remarks are relevant:

- A mixed land use development is proposed on Portion 437 of the Farm Roosboom No 1102- G.S. The proposed mixed-use development will comprise of various land uses including residential, primary school, day care centres and places of worship.
- The proposed development is expected to generate 512 and 507 trips during the AM and PM peak hour respectively.
- The master plan provides a framework and ensures that the proposed development is sustainable from a traffic engineering point of view. The proposed development will have one access off the external road network (Gravel Road). In terms of accesses to various sites, it is proposed that each site will gain access from new internal Class 4 and Class 5 roads.

It is proposed that the existing intersection of R103 and D637 be reconfigured as follows:

- The R103 and D637 should comprise of a 90 degrees T-Junction
- Dedicated right-turn lane (60,0 m) on the southbound direction
- Dedicated left-turn lane (60,0 m) on the northbound direction
- Dedicated right-turn lane (60,0 m) on the eastbound direction
- Single lane in each direction for all the legs of the intersection

The proposed township development will comprise of an intersection that will provide access and connect with the existing gravel Road and will be provided as follows:

- Dedicated right-turn lane (30,0 m) on the northbound direction
- A shared through and left turn lane on the northbound direction
- A receiving lane on the northbound direction
- Dedicated right-turn lane (30,0 m) on the eastbound direction
- A shared through and left turn lane on the eastbound direction
- Dedicated right-turn lane (30,0 m) on the southbound direction
- A shared through and left turn lane on the southbound direction
- A receiving lane on the southbound direction
- Dedicated right-turn lane (30,0 m) on the westbound direction
- A shared through and left turn lane on the westbound direction
- Minibus taxis and buses were observed operating along the surrounding road network.
- There is an existing bus / taxi layby at the intersection of R103 and D637.

It is recommended that the main Class 4 link road within the proposed development have public transport lay-bys in the form of bus / taxi stops at appropriate locations within a maximum walking distance limited to 450,0 m.

It is recommended that a common minibus taxi rank be provided which will serve the proposed township development.

In order to ease and formalise the movement of pedestrians between the site accesses and the recommended lay-bys, it is proposed that 2,0 m wide paved (or dust free) sidewalks be constructed along at least one side of all Class 4 roads within the proposed development. It is also recommended that 2,0 m wide paved (or dust free) sidewalks be constructed along site boundaries of schools and commercial / business and retail nodes.

To improve pedestrian safety, it is proposed that safe pedestrian crossings be implemented at suitable positions on the internal Class 4 roads near schools, commercial / business and retail nodes. This will be addressed in separate traffic impact studies.

From a traffic engineering perspective, the proposed development is thus regarded as feasible and sustainable and is therefore supported.

5.4.6 Geotechnical Investigation

Based on the findings of this investigation, the following issues must be taken into account:

- *Geology*: The site is underlain by sedimentary bedrock materials of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. The sedimentary materials have been intruded by dolerite dykes in places and covered by quaternary and alluvial deposits in lower lying areas.
- *Soil Profiles*: Soil profiles across the site are variable but generally consist of colluvial cover overlying residual profiles of shale, sandstone and/or dolerite materials. Areas of bedrock outcrop occur on site.
- *Groundwater*: Perched groundwater or seepage water was not encountered in trial holes, but it is expected that such water may occur on a seasonal basis and affect the proposed development adversely.
- *Founding Conditions*: The study area is divided into six zones, namely **R or S/R**, **H1/R or S/H1/R**, **S1**, **H1-H2 or S/H1-H2, H3 and H2/H3**. Detailed site and stand zoning must be verified during a phase two investigation. The zoning must also be revised once flood line and groundwater assessments have been completed.
    - *Conditions of Excavation*: Excavations are expected to be affected by seasonal groundwater influx and/or perched water levels. Conditions of clayey excavation may occur in most residual materials, while bedrock materials may need to be excavated or blasted.
    - *Corrosivity:* Some soil materials on site proved to be corrosive, mostly on account of high soil conductivity properties.
    - *Historic Monuments*: To the author's knowledge there are no historic monuments on the site.
    - *Undermining*: The area is not subject to undermining.
    - *Dolomite Stability*: The area is not subject to dolomite related instabilities.
    - *Seismicity*: A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.06g to 0.10g may take place once in 50 years.
    - *Cemetery Sites*: Numerous graves were identified by the site survey team and are indicated on the topographical survey plan.
    - *Insect Nesting:* Insect nesting, such as ants and termites, was encountered sporadically
    - throughout the site.
    - *Eucalyptus Trees:* Cognisance must be taken of the fact that clusters of eucalyptus trees
    - occurred on the western parts of the site.
    - *Erosion and Dispersive Soils:* Erosion dongas were found on site and are likely related to proven dispersive soil materials.

Generally the soil profile and geotechnical condition is considered to be Favourable and/or will require mitigation measures on Intermediate Development Potential soils. Dispersive soils will need to be well managed to mitigate impacts of erosion and storm water run off.

5.4.7 Geohydrological Assessment

Based on the findings of this investigation, the following conclusions were made:

- Regionally the site is located on a water divide whereas the furthest parts on the northern boundary on portion 437 drains to the north and the majority of the remainder of portion 437 drains towards the south. Drainage on portion 502 is expected to be to the north towards the Onderbroekspruit;
- The site is underlain by three main lithological units that consist of quaternary deposits consisting of fine grained sediments, dolerite intrusions and the sedimentary rocks of the Adelaide Subgroup which forms part of the Beaufort Group of the Karoo Supergroup. The Adelaide subgroup bedrock materials consist of grey mudstone, dark grey shale, siltstone and sandstone. No fault zones are indicated in the vicinity of the site;
- The geotechnical studies (Soil Kraft, 2017 and 2019) revealed the majority of the site is underlain by limited colluvium overlying bedrock (sandstone and shale) and colluvium overlying residual soils with shallow bedrock in places;
- The site is underlain by an intergranular and fractured type of aquifer with average borehole yields of between 0.1 and 0.5 l/s. The aquifer is classified as a minor aquifer, with medium susceptibility to contamination and moderate vulnerability;
- In addition to the published sources of information a qualitative assessment of the sensitivity and vulnerability of groundwater and surface water in the vicinity of the site was undertaken. Groundwater sensitivity at the site is classified as **high** as groundwater is utilised in the vicinity of the site to augment the municipal water supply which was reported to be erratic by local resident. The vulnerability of the groundwater is also considered to be **high** as static groundwater depth was less than 10 m bgl and overlain by highly permeable or fractured materials;
- The surface water sensitivity is considered to be **moderate** as the surface water bodies in the region potentially has deteriorated water quality. Surface water vulnerability is considered to be **high** as the perennial Onderbroekspruit cuts through the project site at the border between farm portion 437 and 502;
    - The direction of groundwater flow is expected to emulate the topographical gradient which for the majority of portion 437 slopes towards the south. As the site is located on a water divide groundwater flow is expected to flow to the north on the northern perimeter of portion 437. As for portion 502 groundwater flow is anticipated to flow towards the north towards theOnderbroekspruit;
    - Considering the local geology and climate there is also a high likelihood that a perched water table could develop above the bedrock interface during the rainy season. As the current assessment was undertaken during the end of the dry season the presence of a perched water table could not be verified. The geotechnical investigation (Soil Kraft, 2017 & 2019) also commented on the potential presence of a perched water table during the rainy season.

Field Investigation

- A total of seven boreholes were identified in the vicinity of the site but none were located within the confines of the proposed site boundary. Of the 7 boreholes 4 of these were not operational as they were either obstructed, destroyed, not installed with a pump or didn't have functioning hand pump;
- Functioning boreholes are used for domestic water supply by local residents as the municipal water supply is erratic as commented by local residents.

Laboratory Results

- Groundwater samples were collected from HBH1 and HBH3 and the laboratory results indicate that apart from microbial impact both samples had groundwater quality that meets the SANS241: 2015 drinking criteria for the parameters analyses;

- Bacteriological analyses identified microbial activity in both of the submitted samples with total plate count exceeding the SANS241 criteria. In sample HBH3 *E.Coli* was also identified that exceeded the SANS241 drinking water guidelines;
- The most likely source of microbial impact to the groundwater has probably originated from the multiple pit latrines present at nearby properties. As there is no formal sanitary sewer network all residents have hand dug shallow pit latrines for the disposal of their excreta. For example HBH1 is located less than 20 meters downgradient of a septic tank. Generally buffer distances of at least 75 m from a borehole to the nearest pit latrine is recommended (GW
- Protocol). Hydrocensus boreholes HBH1, 4, 5, 6 and 7 were all located within 75 m from a residential property that had a pit latrine;
- HBH3 that had the highest coliform count as well as detectable *E.Coli* but is not located close to a residential property. The closest upgradient development is the local school located roughly 170 m to the south of HBH3. HBH3 is however located adjacent to Onderbroekspruit and the deteriorated water quality observed in the borehole could be attributed to the potential deteriorated water quality of the Onderbroekspruit. The microbial impact has likely originated from pit latrines, cattle grazing etc located within the upper
- drainage regions of the said surface water feature;
- Sample HBH1 can be classified as sodium bicarbonate/chloride waters while sample HBH3 can be classified as magnesium bicarbonate type water.

Groundwater Impact

- The vulnerability of the groundwater was considered to be high as static groundwater depth was less than 10 m bgl (as measured in HBH3) and overlain by permeable or fractured materials;
- A VIP latrine with a containment pit system is proposed for the development. Such a system should typically have minimal hydraulic output into the receiving environment and therefore **minimal** risk of contamination if operated and maintained properly;
- The overall risk for the development to contaminate the underlying groundwater regime was therefore considered to be medium and some precautionary measures will have to be implemented. It should also be noted that the underlying aquifer is of strategic value to the local community as a source of water and therefore requires a measure of protection from anthropogenic impacts;

Recommendations

To ensure that the development will have minimal impact on the surface and groundwater regimes the following precautionary measures are recommended for the development:

- Considering the potential presence of a perched water table during the rainy season, which could impact on the foundation designs and geotechnical specifications, it is recommended that a limited groundwater study be undertaken during the rainy season. The study should include the installation of shallow hand augered soil bores above bedrock to verify whether shallow groundwater is present;
- It is recommended that grey water volumes are incorporated into the design calculation to allow for more accurate estimation of clean out schedules. This should be done so that no overflowing of the containment pits occur which could contaminate surface and groundwater at and near the development;
- An overarching operational and maintenance plan needs to be developed detailing as a minimum the sequence of collection and inspection of sanitary infrastructure, safe disposal procedures for waste, emergency spill response procedures and assigned roles and responsibilities;
- It is recommended that the Alfred Duma municipality agree to the proposed operational and maintenance plan;

- Although the detected microbial impact has been identified for boreholes located outside the proposed development is it recommended that the Alfred Duma Local Municipality are made aware of the identified microbial impact to groundwater and the state of community wells that require their attention;
- Sanitation facilities should be well maintained and serviced, any breakages or leaks should be fixed immediately to prevent loss of containment;
- Consideration should be given to the implementation of a groundwater monitoring network (As per Section 7.5 of this report) to ensure that the development will have minimal impact on the underlying aquifer. Considering that water supply to the area has been reported as erratic it might be advantageous that some of the groundwater monitoring points be converted to boreholes to serve as an alternative water supply to the local community.

5.4.7 Services Provision

Professional engineers compiled reports on the availability, capacity and location of bulk services that can be used to offer the relevant services for the development.

Water
An existing Bulk Water line bisects the property and can service the site. A link connections can be made into this line and from there various pipes connected to service units. The internal water pipes will be located within the road reserve of the various internal roads. Some of these pipes will need to cross the watercourse and/or sensitive areas (i,e, rocky ridge). This impact is likely to be of Moderate Significance and will require detailed planning and mitigation measures.

Sewerage
The site does not have access to a waterborne outfall sewage solution and n bulk facilities occur in proximity to the site. A cost:benefit investigation concludes that a VIP Laterine offers the most cost effective and sustainable option to service the individual units at this time.

The envisaged system is not likely to impact significantly on the ground water environment as it will be a re-enforced concrete lined and sealed pit system with piped connections to each VIP toilet at each unit.

Stormwater
The development includes constructing units of approximately 50m^2 on erven of 300m^2. The development further includes the use of gravel roads and vegetated pavements. Consequently the storm water run off peak flows from the site are far lower than would normally be expected from an urbanised site. Nevertheless, the transformation of the greenfields site will lead to an increased run off that will need to be attenuated. In addition, the weak soil profile exposes the site to erosion risks.

The proposed storm water management plan includes the construction of various natural earth attenuation ponds. Each erf will be platformed and shaped to minimize storm water run off. Run off will then flow in armouflex channels that will serve to slow the water flow as well as increase permeability into the soil. The channels will eventually drain into an attenuation pond. The outflow structure at each release point will include anti erosion measures to prevent scouring of the soil surface and the slow release of the water. Water will drain to the low point and finally drain into the watercourses.

Wherever the contours allow for it, the release point of the storm water (i.e. headwall) is located above the 1:100 year flood line level. However, certain instances require that the headwall be located below the 1:100 floodline. These structures however are relatively small and will not individually impact significantly on the environment.

Electricity
The site is bisected by various bulk power lines that include a 275KvA line that supplies parts of Roosboom with an 11KvA network. This network will be tied into to provide power to each individual unit. This will be achieved via standard Eskom reticulation systems that include wooden poles and pole transformers. Adequate capacity is likely to exist for Eskom supply and supply for the First Phase of 557 units has been confirmed.

Where power supply needs to cross sensitive areas, this will follow the proposed road network in order to minimize impacts on the environment. The anticipated impact from using pole transformers is likely to be of low significance owing to low ecological footprint for each wooden pole.

Roads
The development will include a number of internal roads to provide access to individual units and cater for transport and movement across the site and into adjoining areas and towns. These roads will be unsurfaced gravel roads of approximately 3m width. Pavements will not be paved.

5.5 Environmental Impact Summary of the preferred (Alternative 1) Layout (Figure 6)

Impact Type	Phase	Significance (Pre Mitigation)	Significance (Post Mitigation)
Risk of geological collapse (undermining / Sink Holes)	C	High	Medium
	O	Medium	Low
Pollution / Contamination of Ground Water	C	Medium	Low
	O	Medium	Low
Reduction in Air Quality (Dust, Smoke, Emissions)	C	Medium	Low
	O	Medium	Low
Topography (Elevated Buildings, Obstruction of View, Change of Character)	C	High	Medium
	O	Medium	Low
Pollution of Surface Water	C	Medium High	Medium
	O	Medium	Low
Loss of Wetland Habitat / Function	C	Medium High	Medium
	O	Medium	Low
Loss of Agricultural Potential	C	Low	None
	O	Low	None
Loss of Faunal Species / Habitat	C	Medium	Low
	O	Medium	Low
Loss of Floral Species / Habitat	C	Medium	Low
	O	Medium	Low
Social / Cultural Impacts	C	Medium High	Low
	O	Medium	Low
Loss of Cultural Historic Features	C	Medium	Low
	O	Medium	Low
Loss of Sense Place	C	Medium	Low
	O	Low	None
Cumulative Impacts	C	High	Medium
	O	Medium	Low
Decommissioning / Latent	C	Low	None
	O	Medium	Low

5.6 Environmental Impact Statement

An ecological and environmental evaluation of the site indicates the following –

- The site is located adjacent to the existing township of Roosboom located 12km south of Ladysmith;
- The development is earmarked in line with the Spatial Development Framework of the area and has been prioritised as a key human settlement to provide housing to a number of beneficiaries that have already been identified;
- From a geotechnical point of view there are no fatal flaws. The site is however affected by a ridge line that precludes development of the central portion. In addition, the shallow soils and dispersive nature of the lower slopes highlight the need for significant soil stabilization requirements to prevent the continuation of erosion impacts;
- The site is bisected by a non-perennial water course and is also affected by a 1:100 year floodline. The wetland and water courses on site have been buffered by 32m and 50m respectively and this has meant that Portion 502 cannot be further developed at this stage. Only the watercourse & part of the wetland area on the west of the site will need to be crossed by a local road to provide access. This will require mitigation to minimize further impacts on the water course. A detailed plan for this has been provided in the EMPr;
- The ecological sensitivities preclude development of the ridge area and wooded rocky grassland. No protected and/or red data species have been recorded on the site and the majority of the site has been historically affected by grazing impacts as well as the establishment of eucalyptus and black wattle trees. The faunal assessment finds a relatively poor assemblage of natural species and the site is located distant from any Critical Biodiversity Areas. Consequently the development will have little impact on the biodiversity of the site or adjacent areas;
- A number of cultural historic features occur on the site. These included a cemetery, graves, historical buildings and foundations, artefacts and historical terraces. Each of the graves and the cemetery identified in the survey will be protected as an open space in the layout. Historical features that provide a Low, Medium or High sensitivity, and that are not worthy of protection, will be recorded and assessed in a Phase 2 Heritage Impact Assessment and an application for a destruction permit will be lodged with SAHRA / AMAFA prior to development of these area;
- The uThukela District Council as well as the Alfred Duma Local Municipality is unable to prove or cater for off site sewage treatment options. For this reason the site must cater for this service. The capital costs however to provide a package plant and/or outfall sewer is prohibitive and for this reason the best practicable environment option is to design a VIP latrine system that includes a lined chamber in which effluent is stored;
- The geohydrological investigation highlighted the generally good quality of the ground water however also noted the effect and influence of septic tanks on the ground water. All of the existing houses in the area make use of septic tank/pit latrine that are neither lined nor managed or maintained and these typically contaminate water resources. This trend highlights the need for a proactive plan to be developed and implemented by the service provider such that this impact is not escalated or duplicated by this development;
- Piped Water to stands and electrical power supply to each house will be possible by the development and the existing infrastructure is located on site. Eskom has already confirmed that 557 units can be provided with power and additional phases will be provided as and when required. The bulk water reservoir currently has inadequate capacity to supply the development although the uThukela District Council has earmarked the expansion of potable water capacity to the larger area;

- An existing gravel road provides access to the site and this provides adequate means of transport to and from the site and area. Additional measures to improve access and cater for access to erven will be provided by the layout plan. The most typical and common form of transport in the area is non-motorised and the layout makes provision for pedestrian traffic, taxi ranks and limited vehicular traffic. The traffic impact assessment finds that the development will have no impact on current or future traffic conditions however the intersection of the gravel road with the N11 (Colenso Road) will require upgrading and modification that is outside the scope fo this assessment and project scope;
- A detailed storm water management plan makes provision for 9 attenuation ponds as well as using armouflex channels and head walls to control and attenuate storm water run off. Storm water anti-erosion measures (i.e. gabion baskets, reno mattreeses) are located at the head walls to disperse flows before they enter into the natural drainage channels. Storm water will thus drain from the area in the natural channel at the pre-development run off rate. The storm water impact is largely lessened with the gravel nature of the roads as well as the fact that residential erven remain largely undeveloped besides the actual household unit;
- The layout makes provision for 863 residential units as well as several community facilities that include crèches, schools, churches and business land uses. This integrated development plan further includes areas for open spaces and storm water management areas as a means to providing a sustainable development layout to provide housing to people of the area;
- The impact assessment as well as findings from the various specialist assessments and investigations suggests that the preferred (alternative) layout will not impact negatively on the environment and/or will not degrade the environment that could not be adequately mitigated by the measures proposed in the EMPr.
- On this basis, we recommend that EDTEA approve the **preferred (alternative) layout - Figure 6** to develop a human settlement on Portion 437 and Portion 502 of the Farm Roos Boom 1102GS.

Table 23 below provides a comparative assessment of the various alternatives considered in this report.

Table 23: A comparative assessment of alternatives

Alternative	Advantages	Disadvantages
No GO	Greenfields site that will remain as informal grazing land bisected by a non-perennial water course. This option caters for climate change objectives (i.e. acts as a carbon sink). The run off of water is largely attenuated across the site. The site remains as a visually appealing landscape.	The area will continue to erode owing to the lack of funds or resources to stabilize key areas such as the non-perennial water course, erosion gullies, spread of exotic plants that include the eucalypts and black wattle. Other exotic plants could invade the area as adjoining areas are developed. The continued impact of the existing pit latrines within proximity to the site will negatively impact on the ground water. The area will continue to have no services. The risk of informal settlement and/or land invasion will remain. The risk of the area being used as an informal waste dump will increase over time as development in adjacent areas continues The opportunity for jobs and housing for qualified beneficiaries will not be aided or realized.

Development Proposal (Layout 4A)	This layout makes provision for approximately 1000 residential 1 stands across the site. This offers the optimum number of stands for the qualifying beneficiaries that are desperate in need of housing, jobs and relevant services.	The layout does NOT address or consider various environmental sensitivities that include sensitive ecological areas, wetlands and watercourses, cultural historic features and relevant buffers. This layout is thus unsustainable and will give rise to impacts that may degrade the environment.
Alternative 1 (Layout 4B)	This layout had to offer fewer residential units whilst catering for the environmental constraints of the site. In order to address this, options for group housing were included in the layout so as to meet the objectives of the development. This layout also made provision for housing on Portion 502 as well as options to link P437 and P502. This linkage could then offer services to P502.	This layout (that was preferred as part of the scoping report) fails to address several environmental sensitivities that were identified during the EIA Phase. The layout infringes of the wetland and riparian buffer as well as the 1:100 year floodline area The layout impacts on the ecological sensitive areas that include the wooded rocky outcrop The layout impacts directly on several cultural historic sensitive areas including some graves and other features of significance.
Alternative 2 (Layout 6)	This layout aims to both include the ecological, wetland, water course, cultural historic as well as other biophysical constraints of the site. The layout excludes development within or on sensitive areas (i.e. units are above the 1:100 year floodline, out of sensitive ecological areas and do not directly impact on cultural historic areas that are significant.	The layout is a more sustainable development option for the site however it will need to be amended and/or updated to include a more recent SDP that either prevents the development of all significant cultural historic features or other include a Phase 2 Heritage Impact Assessment process. The development of P502 is not possible as this land is significantly affected by the 1:100 year floodline and the 50m riparian buffer.

5.7 Concluding Opinion

Eco Assessments, as independent environmental assessment practitioners, recommend to the relevant authorities that the **Preferred Alternative 1 Layout (Figure 6)** be favourably considered.

Based on the information presented in this Environmental Impact Assessment Report, we are of the view that the environment will not be detrimentally impacted upon by undertaking the proposed activities or alternatively that the recommended Environmental Management Plan (see Section 6) can be used to mitigate impacts such that they do not significantly impact on the environment.

SECTION SIX – ENVIRONMENTAL MANAGEMENT PLAN REPORT

ENVIRONMENTAL MANAGEMENT PLAN
Proposed development of a human settlement / residential township on Portion 437 and Portion 502 of the Farm Roosboom 1102 GS - Ladysmith KZN

Compiled for:

Alfred Duma Local Municipality

Compiled by:

Ecological & Environmental Consultants

Eco Assessments cc
PO Box 441037
LINDEN
2104

Tel. 011 782 3428
Fax: 011 888 9588
info@ecoassessments.co.za

This report has been compiled by Mr Mark Custers (Pr. Sci Nat – 400026/02) who has over 20 year's experience as an environmental manager including 20 years' experience as an Environmental Control Officer (refer to Appendix B)

Signed:_____

Report Date: February 2020
Our Reference: 1450/18 EIA
EDTEA Reference: DC23/0007/2019 - KZN/EIA/0001155/2019

6.1 Introduction

The purpose and intent of an environmental management plan (EMP) is that it provides guidelines, processes and procedures that can ensure that the environment is not detrimentally affected by the proposed development. This includes strategies for monitoring the impacts on the site.

This document considers the impacts that are likely to arise from the establishment of the development on the site and measures that are recommended and prescribed to minimize the significance of these impacts on the environment.

The EMPr considers the environmental impacts and aspects that the development is likely to trigger, lists the environmental objectives and outcomes for the site, specifies impact management actions to meet the objectives and includes relevant time frames, frequencies and responsibilities for relevant actions that includes steps and measures to monitor, track and report on compliance.

This EMPr has been prepared by M Custers (Pr. Sci Nat – 400026/02) who has over 20 year's experience as an environmental manager including 20 years experience as an Environmental Control Officer for various projects that include residential developments, road construction, powerlines, pipelines, industrial development sites and office sites (**Appendix B** – Curriculum Vitae of Mr M Custers).

It is therefore suggested that in the event that EDTEA requires additional information that this be provided as part of a pre-compliance condition to any environmental authorisation. This would both promote sustainable development as well as support sound business sense that encourages the ease of doing business in KZN.

6.2 Project Description

6.2.1 Locality of the Site

The site is located on Portion 437 and Portion 502 of the Farm Roosboom 1102GS located 12km south of the town of Ladysmith in Kwazulu Natal (Plan 1 - **Figure 1**).

6.2.2 Layout & Development Planning

The development entails the establishment of a human settlement / residential township on the site. A preferred layout indicates the following key land uses and development activities (Plan 2 - **Figure 6**).

Table 24. Details of the Preferred alternative layout

Landuse	Erf Number	No. of erven	Area	Percentage
Residential 1	1 to 561	561	21.17	26.10
Residential 1 (encroachments)	562 to 596	35	5.84	7.20
General Residential (Res 3)	597 - 598	2	6.64	8.18
Educational	599	1	4.17	5.15
Community Facility - Creche	600 - 601	2	0.28	0.35
Community Facility	602 - 605	4	0.60	0.75

- Church				
Community Facility - Clinic	606	1	0.18	0.22
Business 1	607	1	0.41	0.5
Public Open Space (attenuation ponds)	608 - 620	9	1.47	1.81
Public Open Space	621 - 635	18	27.32	33.67
Roads			12.81	15.80
Total		634	81.14	100

The development is proposed to encompass –

- Residential 1 erven (including the encroachments areas) that total 598 units.
- Residential 3 erven that total approximately 265 units at a density of 40du/ha
- Various educational, community and business erven that total 9 units
- Public open spaces allocated for storm water management and attenuation
- Public Open Spaces that include open spaces and buffer areas to protect the ecology, cultural heritage features as well as water courses and wetlands
- Roads that provide access and mobility spines

Various infrastructure link services (roads, water, sewage, storm water and electrical supply) will need to be constructed on or across the site (see Section 6.3 below).

6.2.3 Development Activities

The following list of activities in terms of the EIA Regulations of 2014 (as amended) is likely to be triggered by the development:

GN 327 (07 April 2017)	11	Not triggered
GN 327 (07 April 2017)	12	The construction activities will include the development of attenuation ponds, weirs, low water bridges, storm water outlet structures and other infrastructure with a footprint greater than 100m^2 within 32m of the water courses. The site lies adjacent to an urban area. This infrastructure will be necessary to manage and control the run off of storm water across the site and protect the site from erosion or localized flooding. The exact points and positions of the SWMP will be provided in the EIA phase of the project.
GN 327 (07 April 2017)	19	The construction activities will include excavation of an accumulated volume of more than 10 cubic meters of soil and sub-soil to form the foundations for the development of attenuation ponds, weirs, low water bridges, storm water outlet structures and other infrastructure with a footprint greater than 100m^2 within 32m of the water courses. The site lies adjacent to an urban area.
GN 327 (07 April 2017)	24	The proposed township includes the construction of several internal and link gravel roads to provide access to the units. The internal roads will also need to link to the existing gravel roads that bisect the residential areas of Roosboom that lies adjacent to the site.
GN 327 (07 April 2017)	25	Not triggered
GN 327 (07 April 2017)	28	The development will create a residential township larger than 1 hectare in extent on land that has not formally

		been used for agriculture since 01 April 1998 and that lies adjacent to an urban area. The site however has not been previously developed.
GN 325 (07 April 2017)	15	The construction activities and establishment of the township will clear an area greater than 20 hectares of indigenous vegetation.

The development will include the clearance of an area of more than 20ha of indigenous vegetation. In addition, the development will include the construction of a road that crosses a water course and wetland on the western extent of the site. This will require the excavation of the channel and infill of the foundations with soils and rock. The road will include a standard design for a gravel road with a width of less 6m.

Relevant services (water pipes, storm water pipes and electrical cables) will cross the water course along the proposed road alignment so that impacts are not duplicated.

Electrical supply will tie into the existing 11KV reticulation grid and will include wooden pole transformers that supply power to each house.

Piped water will be provided to stand pipes located 200m apart. These will be supplied from the existing bulk water line located along the main gravel road.

Sewage will be drain from each household that will be provided with a VIP toilet. Effluent will drain into a lined pit latrine.

Gravel roads will provide access to each household and the internal road network links to the main gravel road that connects with the N11 (Ladysmith Colenso Road). An internal road will traverse a watercourse & wetland area that will include boxed culverts to promote the free flow of water under the road. Anti-erosion structures will be used to stabilize disturbed areas, construction areas and areas where storm water may accumulate. This will include attenuation ponds that will drain into the relevant water courses.

The development of the site will be undertaken in relevant phases (refer to Plan 3 - **Figure 19**) so as to discourage the environmental impact. A total of four (4) phases is proposed. The development is likely to extend a period of approximately 5 - 8 years. The first phase is envisaged to be located close to existing infrastructure that will gradually be rolled out to service the needs of the beneficiaries.

6.3 Infrastructure Plan & Link Services

All relevant services are to be catered for on-site as follows below:

6.3.1 Access. Access to the site will off the existing gravel road.

6.3.2 Potable Water Supply. The existing bulk water supply line that runs along the gravel road will provide piped water to stand pipes located 200m away from each other. Water is sourced from the uThukela District Municipality via the existing reservoir that will need to be upgraded by the District Municipality to provide sufficient capacity. This falls outside the scope of this assessment.

6.3.3 Fire Water will also be supplied via the existing potable water supply system and existing reservoir that needs to be upgraded to provide relevant capacity to the development.
.

6.3.4 Sewage services will be provided by means of a VIP Latrine system. The substructure or pit of the **Ventilation Improved Pit (VIP) Toilet** to be implemented on this

site will be rectangular even though in some instances circular pits have been commonly used in recent times. The walls of the pit will be lined with 300mm thick reinforced concrete walls. The pit will operate as a dry pit and all the sludge will be retained in the pit. Decomposition will be aided by adding Sannitree **Double Action Bio-Enzyme Granules** which are a blend of freeze-dried bacteria and enzymes specially formulated to rapidly digest organic waste, reduce bad odours and the fly population found in and around pit latrines.

A minimum space of width of 1.20m and length of 1.20m should be provided for every squatting space.

A bin for hygienic disposal of sanitary materials must be provided in every chamber in the latrine.

The substructure should not be closer than 2.75m from the boundaries of the plot. Access must be provided for maintenance/emptying crews.

The pit should be 30m away and downhill from any borehole or well. It should be on slightly raised ground with firm soil. It should be conveniently located near the house and away from trees.

Generally, the pit volume depends on the solids accumulation rate, the number of users, and the desired life of the pit. A free space at the top of the pit, usually 0.5m must be allowed for in the design. The pit should have sufficient volume/capacity to be in use for at least 10-20 years of continuous use without emptying. In dry pits the solids accumulation rate varies between 0.03 and 0.05m^3 per person per year. The use of Sannitree **Double Action Bio-Enzyme Granules** will reduce the typical solid accumulation rate to within a range of approximately 0.02 and 0.04m^3 per person per year.

Design check for Anticipated Sludge accumulation

For the proposed system with 1 household being serviced by one pit. 1 rural residential unit is expected to generate an average sludge of;

(0.04m^3/ca/yr) x 10.0 ca/unit x 1unit = 0.4m^3/year

Adopting a **3.5m** wide x **4.0m** long x **1.5m** deep tank to service a single Households will provide **16.1m^3** *(see contaiment pit configuration on Drawing No: S-C-VIPLLL-01RevA)* capacity which is adequate to contain the sludge generated in a single house hold for a period of 25 years without emptying the pit.

The bio-enzyme has a double-action formulae which is specially formulated to rapidly digest organic waste. It also contains an active ingredient which attacks the larvae of flies, preventing them from shedding their skins. As this is an essential part of the larvae's growth and development, this double action product effectively stops the larvae from turning into flies.

We recommend that the bio-enzyme granules (100g sachets) be added once annually. A 100g sachet can be utilized on two pits 16m^3 pits. Each 100g sachet costs approximately R50.00

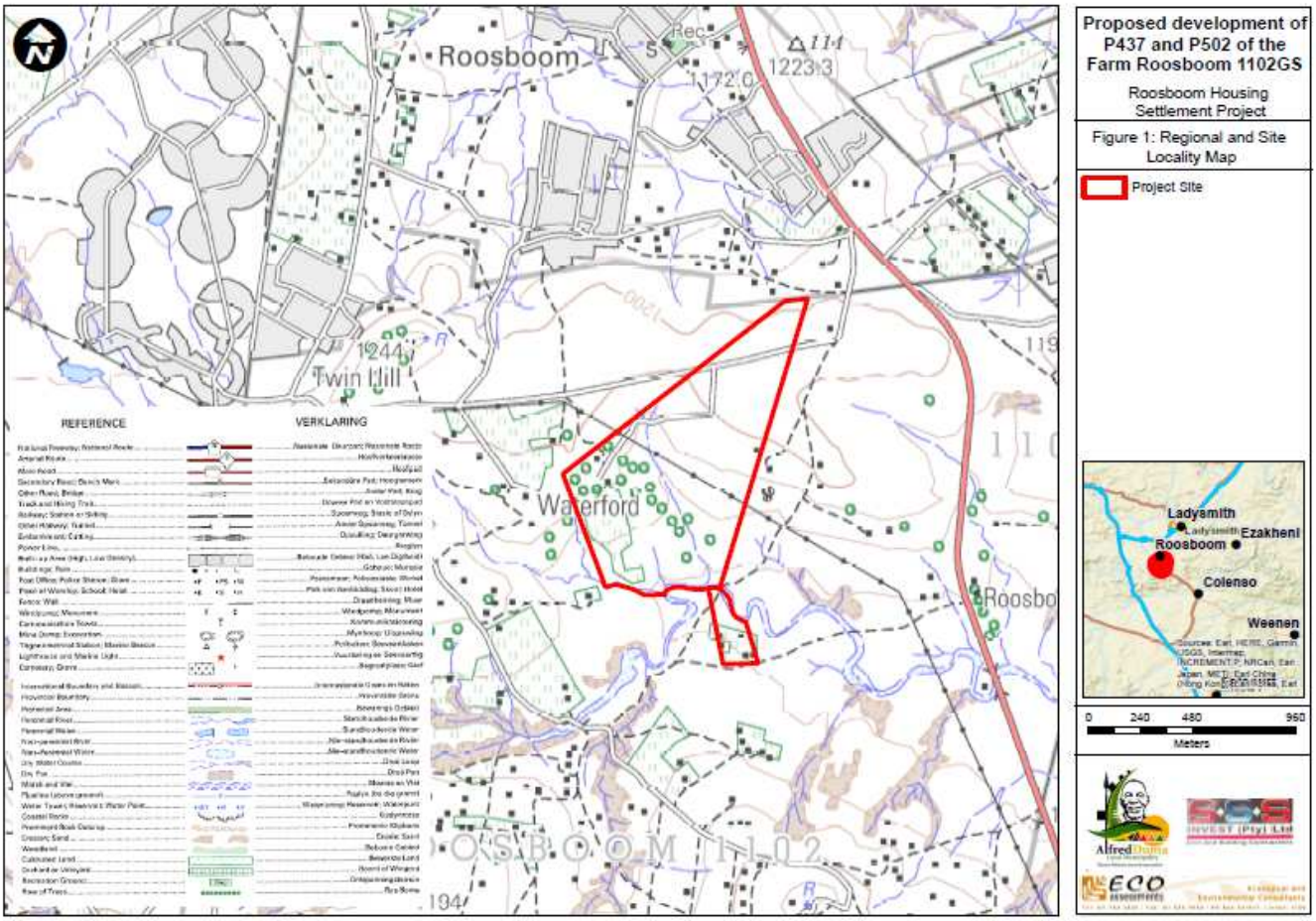
Benefits of using Bio-Enzyme Granules

- Rapidly digests organic waste assuring easy pump-outs
- Attacks and neutralises fly larvae
- Reduces bad smells
- Non-hazardous to people, animals and water bodies
- Can be beneficial when discharged after pumping to sewage treatment works

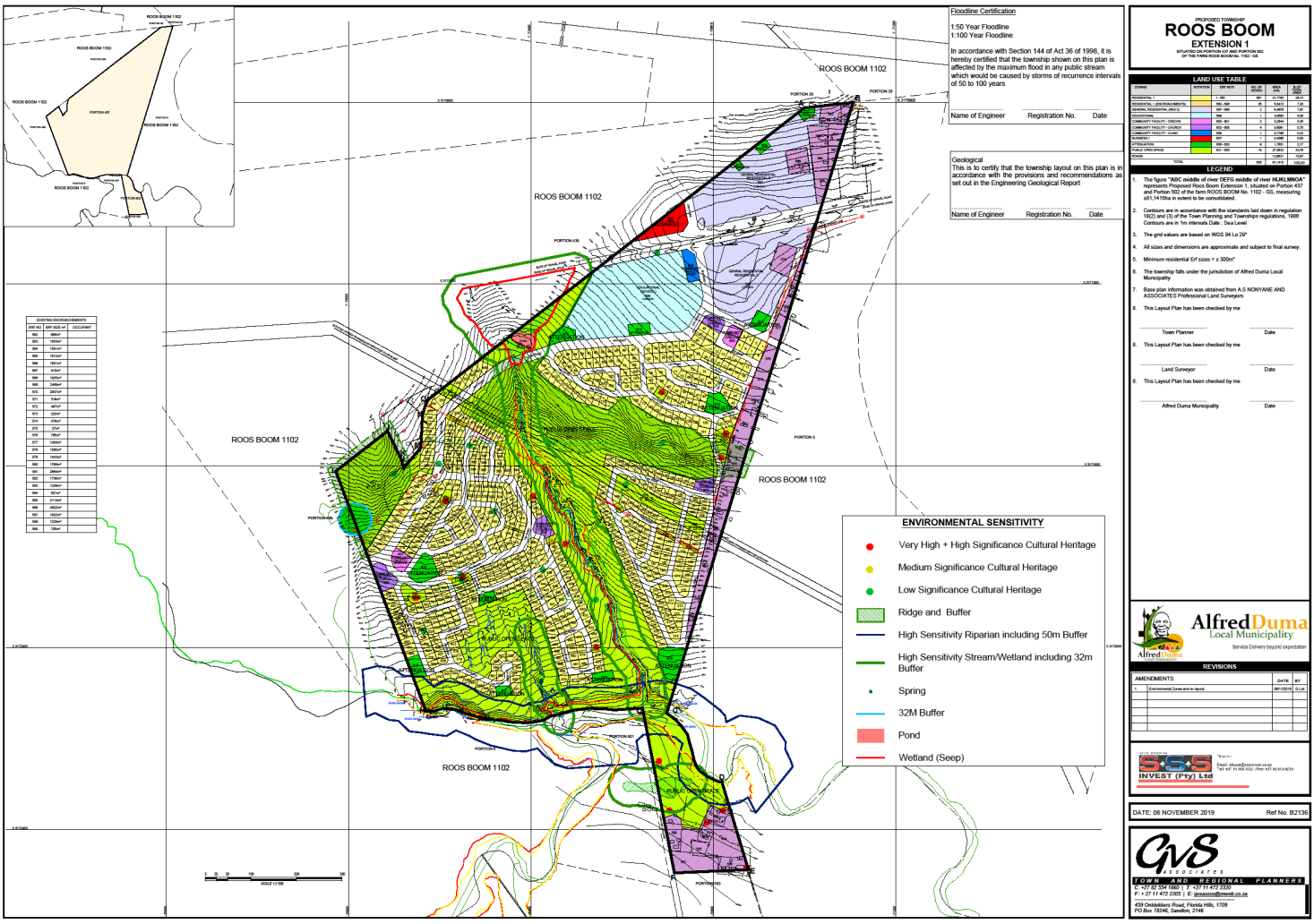
6.3.5 Storm water is to include the installations of armourflex channels to control and direct storm water run off to attention ponds located across the site. These ponds will capture the peak run off and allow for the water to drain via a headwall and anti-erosion structures to slow the water flow. Run off water will then enter the natural drainage channels that freely drain the site and area.

6.3.6 Electrical supply will be provided to the site by means of the existing Eskom 11KV system. Pole transformers will provide power to each household by means of overhead electrical cables mounted on wooden poles..

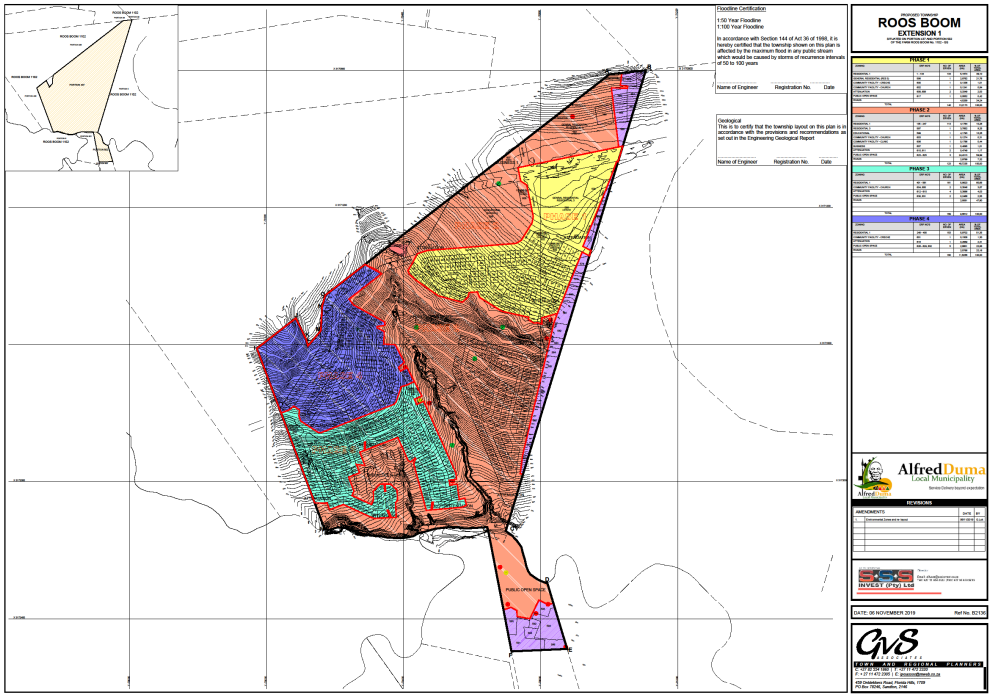
6.3.7 Solid Waste Management will be collected by the local municipality. A system will be developed to allow land users to recycle waste using various container systems as well as by creating opportunities at the crèches, schools and churches for people to reuse or recycle waste materials.



Plan 1. Site Locality Map (refer to **Figure 1**)



Plan 2. Preferred Site Development Plan (refer also to **Figure 6**)



Plan 3. Phasing Plan (refer to **Figure 19**)

6.4 Method Statement of EMPr

The EMPr and relevant management actions has been formulated to address the five (5) development phases of the project. These include planning & design, pre-construction, construction, post construction and operation.

Phase 1 Planning & Design
In the event of a positive EA, the applicant will have to commence with development within a period of 10 years. This phases will have to include obtaining relevant Town Planning Approvals that include a Site Development Plan, Final Fire Management Plan, Final Emergency Response Plan, a final agreement with Company that must comply to the EMPr and relevant conditions of the Authorization. This phases must also include preparations to relocate relevant services, obtaining relevant wayleaves, and the formulation of tender conditions that must include costings and budget to manage the environment and address the requirements of the EMPr.

⇩

Phase 2 Pre-Construction
This phase will include the establishment of the contractor's camp and the delineation of the work area. Relevant protocols and procedures will be established during this phase to ensure that relevant elements and actions of the EMPr are provided for so that impacts on the environment are minimized and/or mitigated. This includes for example the appointment of relevant professionals to the team, provision of relevant services for staff, co-ordinating a staff awareness program, co-ordinating a community liaison procedure to inform the adjacent land owners and members of the community, preparing for and putting in place measures to prevent erosion, fire, run off, pollution, accidents, crime, etc and securing the property & work areas.

⇩

Phase 3 Construction
This phase deals with the construction activities and the mitigation measures that will need to be applied to reduce the significance of the impacts these activities may have on the environment.

This phase includes clearing the site, levelling the site (cut to fill where and only if necessary), blasting to remove bedrock (where and only if necessary), creating the site platform, installing civil/electrical services, constructing the tank farm, constructing the foundations for the buildings, constructing the forecourt, constructing the storm water attenuation ponds, linking relevant services and constructing the access and egress routes.

⇩

Phase 4 Post Construction
This phase includes measures to close the construction activities & rehabilitate the site and ensure that latent impacts are minimized and/or prevented. Activities relevant to this phase include testing the relevant municipal services to obtain a Section 82 Certificate/Occupational Certificate, removing all litter, building materials and equipment from the site, closing the contractors camp & rehabilitating the site.

⇩

Phase 5 Operation incl. Emergency & Contingency Measures
This phase includes measures to ensure that the environment is not polluted or contaminated by the operational activities at the site. These activities may include litter accumulation, waste accumulation, risk of fire, risk of ground water contamination due to leakages and spills, accidents, crime and noise. Although not all of these impacts can be prevented, measures are prescribed that will reduce the occurrence and intensity of the impact on the environment.

Schematic Illustration of the Process Flow Diagram

6.4.1 Planning and Design

In the planning and design phase, the contractor must be made aware of the issues and impacts surrounding the proposed development. The Contractor must have a copy of the EMP and be familiar of its contents. The Contractor must know how he will manage the waste that will be generated during the construction phase.

An independent Environmental Control Officer (ECO) should be appointed to oversee all environmental aspects relating to the development and ensure that the development is compliant to the Record of Decision and the EMP.

The ECO shall provide a pre-construction, mid-construction and post-construction audit report to EDTEA.

Weekly or at least monthly audit reports shall also be made available to all the relevant parties or as and when required.

6.4.2 Site Establishment

During site establishment, the construction camp must be set up in a position where it will have the least effect on sensitive areas and on surrounding landowners. It must be secured and adequate facilities must be installed for staff such as chemical toilets, potable water etc. Chemical toilets must be provided for construction workers prior to the commencement of any construction activities. These must be regularly maintained and emptied as and when required

A complaints register must be kept at the construction camp. All complaints, issues and concerns shall be incorporated in feedback reports to EDTEA. Where a complaint requires corrective action, this must be communicated to the relevant parties to ensure that the complainant is satisfied. Interested and Affected Parties must be notified when construction activities are to commence.

During site establishment topsoil is of particular concern and must be management is such a way that it can be used for rehabilitation purposes when the time comes.

In this phase, sufficient time must be spend to train staff on their responsibilities regarding the environment. Therefore, an initiation meeting at the end of site establishment, must be held with professional staff and contractor personnel to ensure a thorough understanding of the EMP. This must be minuted and recorded. This meeting must include the following role-players: Client (as may be required), Contract Manager, ECO, Site Agent, Site Health and Safety Officer, Architect, Electrical Engineer, Civil Engineer, Landscape Architect, Town Planner and relevant other key personnel.

Communication channels between the ECO, Site engineer and Contractor should be established.

6.4.3 Construction phase

Bi-weekly meetings and bi-weekly walkabouts will allow the ECO to assess activities on site and make suggestions or suggest corrective actions where necessary.

All environmental incidents e.g. pollution of soil, should be recorded. The damage should be repaired or rehabilitated appropriately. Environmental incidents that are more serious in nature, or showing a clear disregard of the EMP, will be recorded as such and addressed separately.

When planning ahead, the contractor should anticipate activities that might impact on the environment, and should communicate with the ECO with regard to such activities.

6.4.4 Post Construction and Rehabilitation Phase

In the Post Construction phase, the site must be cleared up and repaired where necessary. Areas that were cleared for construction purposes such as the contractor's camp should be restored to its original condition. Stockpiled topsoil and indigenous vegetation should be used for all rehabilitation purposes. The rehabilitation plan must ensure that erosion is prevented and that vegetation is established in areas where no development will occur. Such rehabilitation efforts should be monitored until a 80% success rate has been reached.

6.4.5 Operational phase

During the operational phase, new owners and land managers will be responsible for managing the site. More role-players is likely to be part of the management of the site. The role of the ECO in this phase is to ensure that environmental objectives are carried forward by the new set of land managers and that they are equipped to manage the site sustainably.

6.4.6 Roles and responsibilities

An **Environmental Control Officer** is appointed at the start of the project and is mandated to do the following:

- Ensure that the contractors are fully aware of their responsibilities in terms of the EMP;
- Any damage to the environment must be repaired as soon as possible after consultation between the ECO, Consulting Engineer and Contractor;
- The ECO must ensure that the developer staff and contractor adhere to the EMP;
- The ECO shall be responsible to monitor the construction activities throughout the project by means of meetings and site visits;
- The ECO and contractor shall ensure the cleanup and rehabilitation of the site prior to transfer of properties;
- A post construction audit is to be done to ensure that all the conditions of the EMP have been adhered to;

Project Manager (of Developer)

- The Project Manager will appoint the contractors and will ensure that the development is implemented according to the requirements set out in the EMP.

Contractor

- The contractor must communicate regularly with the ECO and Project Manager to anticipate impacts and find adaptive management measures to prevent such impacts. If he is uncertain of certain activities may affect the environment, me must communicate with the ECO for clarification before actions are implemented. The attention of the contractor to environmental issues, will also contribute to environmental awareness of the workforce which may be carried forward to other living environments.

6.5 Impact Assessment & Environmental Aspects

The following environmental aspects have been assessed to determine their relevance and potential impact on the site and surrounding environment.

These include -

6.5.1 Air Quality (Odour and gaseous emissions, dust particulate emissions)

The site is located is in proximity to peri-urban, rural and residential areas that could potentially be affected by dust impacts. The development does not include any noxious or other industries and/or businesses or activities that could potentially emit noxious gases and/or odours. The development will however make use of VIP Pit Latrines that could possibly give rise to odours and/or flies in the event that these spill and/or overtop when full. A proactive plan has been developed whereby the effluent in the structure will be regularly minimized, maintained and inspected for damage. This will assist in minimizing impacts on the air quality.

6.5.2 Noise

The site is not currently affected by any noise impacts and the ambient noise level is low. The frequent use of the road and activity of people in the area, especially during the construction phase, is likely to elevate this impact and thus requires management and control.

6.5.3 Surface Water

The site is bisected by a non-perennial water course and several water sources occur on the site. The site is relatively steep and measures will be required to control the run off water and minimize erosion impacts. These activities will trigger the need for a Water Use License application to be submitted to the KZN Department of Human Settlement, Water and Sanitation.

6.5.4 Soil Quality

Parts of the site offer suitable building material however no rocks or materials may be re moved from any sensitive areas. The site is located distant from nearby sources of building materials or equipment and appropriate planning must be developed to sources, transport and store materials safely and securely on site.

6.5.5 Groundwater Management

A number of boreholes exist in the surrounding area that are used to supply potable water. These invariable are contaminated by the current presence of several shallow pit latrines close to these boreholes even though the aquifer and soil conditions suggest that the movement of the faecal microbes is thus slower. The development proposes VIP Latrines with a containment pit constructed or re-enforced concrete and designed so that it can be regularly emptied and maintained. Through the use of Bioenzmes the toilets further promote a more compact sludge. The current design is not likely to impact significantly on the ground water and/or aquifer and thus will yield a moderate impact. Nevertheless the proposed VIP latrines will trigger the need for a Water Use License application to be submitted to the KZN department of Human Settlement, Water and Sanitation.

6.5.6 Flora & Fauna

The development will lead to the clearance of more than 47ha of indigenous grassland vegetation that has partly been impacted by historical and past agricultural practices. The rocky ridge and watercourses and wetlands however are regarded to be sensitive and therefore must be protected from development impact.

No red data fauna or flora was recorded on site and the site does not lie in proximity of any significant natural or protected areas. The site lies instead within an area earmarked for urban development and relevant access/transport services exist in proximity to the site.

Natural areas that need to be protected include a buffer of 15m and these areas should be included into a functional open space management area to prevent their degradation and/or destruction over time.

6.5.7 Heritage

Several cultural historic features occur on site. These include an old farmstead (that has been destroyed over time), and associated cemetery and cultivated lands, several graves and other artefacts spread over the site.

The significant items require protection and preservation (i.e. the cemetery and graves) where the old homestead and cultivated areas will require a Phase 2 application for a destruction permit. This will also include Cultural Historic Management Plan including a SDP that will be lodged with AMAFA/SAHRA for approval.

6.5.8 Social

The development lies on the edge of formal residential areas that includes several social facilities including a school, community centre, shops and churches. The development will include housing for approximately 1000 units and this will require the provision of relevant services to cater for the needs of the community. These include shops, schools, crèches, transport facilities, churches and the like.

The development further is likely to create and offer a number of jobs and employment opportunities during the construction and as well as operational phases of the development. Local labour is in short supply and efforts should be created to provide work and job opportunities. Local businesses should also be supported during the development phases of the project.

6.5.9 Geological / Structural (Vibration, Dewatering and Collapse)

The geotechnical assessment of the site noted that the manual excavation of the site was not recommended owing to the presence of unsafe conditions. In addition, the intermediate development potential areas will require detailed re-assessment and appropriate foundations to circumvent cracking, collapse, settlement and heave conditions on site.

It was also recommended that the presence of ground water and/or a perched water table be investigated to ensure that the foundations characteristics and recommendations are verified.

6.5.10 Safety (Occupational Health & Safety)

Any construction site poses dangers and therefore adequate measures must be implemented to minimise the impacts on the Health and Safety of the public, workers and visitors to the site. The site is however distant to the public and only a small work force will be used to construct the site.

Mitigation measures include the use of Personal Protective Equipment, the delineation of the work area by erecting a fence to secure the site as well as the compilation of a Site Safety Plan. The SSP should include details of –

- The responsible person;
- The nearest medical facility
- Risks and safety and emergency procedures associated with each operation
- Decontamination Procedures (for personnel and equipment)
- Appropriate Supervision
- Control to be used
- Safety Equipment and First Aid Procedures
- Training and Education of Employees and Supervisors

6.5.11 Compliance Monitoring

The ECO must visit the site regularly and report on compliance to the EMP as well as requirements of the EA. This must take the form of a photographic record of activities on site, steps to improve environmental performance as well as a record of environmental performance by the responsible party to date.

Biweekly site inspections are proposed along with a monthly monitoring report and Mid to End construct audit report.

The ECO and SEO as well as Site Engineer must meet monthly to discuss, record and report on environmental performance. The ECO must ensure that adequate project information is made available to guide environmental management on site during the pre-construction, construction and post construction phases, or as and when needed.

The anticipated length of the construction phase is approximately 12 - 36 months.

6.5.12 Emergency & Contingency Measures

The operation of a public garage presents several risk events that could potentially impact on the site, surrounding properties as well as the public.

Typical examples of the above include –

- Uncontrolled fire and explosions due to refuelling accidents or accidents on the fore-court

- Earthquake, ground tremor, soil collapse, flooding

- Accidental damage caused by collision by an aeroplane or heavy vehicle

- Acts of terrorism, theft or other illegal events

6.6 Management Actions and Proposed Management Programme

SE = Site Engineer, ECO = Environmental Control Officer, C = Contractor, RP = Relevant Professional, SEO = Site Environmental Officer

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
PLANNING & DESIGN (A)				
Access to Site	Ensure that site is safely accessible for all vehicles & equipment	Obtain Approval from GDRT to access the site	RP	Prior to commencement
Air Pollution	Ensure that activities on site do not contribute to nuisance dust pollution or other emissions including smoke	Ensure that vehicles that access/move on the site do not cause air pollution by regularly damping down the site. No fires may be lit on site. Alternative forms of heating / cooking (with LPG) must be provided where necessary Limit the speed of vehicles on site to 30km/hr	RP / SE	Prior to commencement
Alien Plants (Eucalyptus & Black wattle)	Ensure that alien plants that occur on site are removed from site)	The exotic and alien plants (eucalyptus & black wattle) that occur on site must be removed by developing a work plan. This must include felling the trees, cutting up the branches and providing wood (where feasible) to the local community. Stumps must be removed by a stump chipper that returns the wood to the soil. Alternatively stumps must be treated to prevent coppicing and regrowth.	RP / SE	Prior to construction
By Laws	Ensure compliance to all relevant by-laws	Obtain a list of all relevant by-laws; Cross-check the layout with the relevant by-law Implement checks during the construction phase that ensure compliance with the by-law Undertake an annual self-regulatory audit during the life of the project to ensure compliance	RP / SE	Prior to commencement During construction Operational

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Cultural Historic Features including graves, buildings, cemeteries and other relevant artefacts and finds	Ensure that all cultural historic features and artefacts are protected and/or permitted prior to their loss, destruction of damage	Appoint a cultural historian to undertake a Phase 2 cultural historic assessment of the site; Lodge the relevant applications for destruction permits or the like with the relevant authorities that include SAHRA and AMAFA Obtain approval prior to proceeding to the site establishment Phase	RP / SE	Prior to commencement
Environmental Awareness and Staff Training	Ensure that all site personnel have a basic level of environmental awareness and that are skilled and knowledgeable in their duties, jobs and posts.	Prepare an Environmental Awareness programme for review by the ECO that covers topics relevant to construction activities and impacts on the environment at the site Provide for relevant translators to ensure message is understood by all Provide for awareness posters on the site to mitigate impacts of noise, littering, pollution, unsafe work conditions, etc. Encourage a clean site policy i.e. good house cleaning Enforce a strict work code that prevents alcohol on site, noise, unsocial behaviours, harvesting of fire wood, illegal occupation on site and criminal activities Employ only legal citizens with valid work permits and that have a proven track record to eliminate risks of crime and criminal activities	RP / SE	Prior to commencement
Environmental Control Officer	Ensure that activities on site are compliant with the requirements of the EMP and EDTEA	Appoint an independent Environmental Control Officer to oversee environmental aspects of the development	Developer / ECO	Prior to commencement
Geology & Soils	Ensure surface stability Ensure that damp does not rise from underneath structures	Undertake site specific geotechnical investigations to verify the status, sensitivity and development requirements for the relevant site and areas Decide upon foundation types for the structures from those suggested in the geotechnical report/Engineering Reports Include the necessary precautionary measures in	RP / SE RP / SE	Prior to commencement

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		design		
Groundwater monitoring & verification	Ensure that groundwater quality is constantly monitored.	A ground water monitoring plan is to be prepared by the client before construction. Considering the potential presence of a perched water table during the rainy season, which could impact on the foundation designs and geotechnical specifications, it is recommended that a limited groundwater study be undertaken during the rainy season. The study should include the installation of shallow hand augered soil bores above bedrock to verify whether shallow groundwater is present; An overarching operational and maintenance plan needs to be developed detailing as a minimum the sequence of collection and inspection of sanitary infrastructure, safe disposal procedures for waste, emergency spill response procedures and assigned roles and responsibilities; It is recommended that the Alfred Duma municipality agree to the proposed operational and maintenance plan; Although the detected microbial impact has been identified for boreholes located outside the proposed development is it recommended that the Alfred Duma Local Municipality are made aware of the identified microbial impact to groundwater and the state of community wells that require their attention	RP / SE	Prior to commencement
Landscape Development Plan as part of SDP approval	Ensure that a landscape development plan is provided as part of the SDP for the project	The landscape development plan must address requirements of the Local Municipality Department of Integrated Environmental Management. Only indigenous species may be used in the landscaping of the site. Any indigenous plant that can be used for landscaping must be adequately relocated onto the site or adjoining areas.	RP / SE	Prior to commencement
Local Labour Action Plan	Ensure that the development offers benefit to the local community through the	The developer must compile and develop a local labour action plan that includes the use of local	RP / SE / Developer	Prior to commencement

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
	use of local labour and local expertise and businesses	businesses and expertise to encourage and support job employment in Roosboom and surrounding areas. Only where this resource is not available, should outside contractors be used in the development		
Location & Establishment of Contractors Camp	Ensure that the contractors camp is located distant from adjacent properties to as to prevent impacts such as noise, visual intrusion and crime impacts	The proposed site will be used as the contractors camp. Additional space (on adjoining properties) must include obtaining the land owners written consent / permission The contractors camp must allow for / be limited for – No overnight accommodation unless only for security personnel Adequate parking for vehicles and staff Adequate drainage to prevent standing water Ablution facilities including temporary toilets located away from adjacent properties Waste Management Area including skips for builders rubble, general waste and recyclables (glass, paper, plastic) Bins (210L) or litter bags for site use Management Office	RP / SE	Prior to commencement
Material Sourcing	Ensure that materials are sourced in a legal and sustainable way to prevent degradation of the environment	No illegally sourced materials will be permitted on site. Adequate documents must be presented upon request that all materials have been sourced from accredited suppliers and sources. This includes metals, soils, stones, aggregates, sand, fuels, etc.	RP / SE	Prior to commencement
Material Storage	Ensure that materials stored on site do not contribute to pollution or impact on the community	Storage areas must be positioned to prevent impacts on the adjacent land owners Areas must be secured (fenced off) to prevent crime and theft, illegal access and to eliminate safety risks Flammable materials must not be stored less than 50m from adjacent properties All chemicals, fuels and corrosive or other chemicals/materials must be stored under cover and secured by lock and key Material Safety Data Sheets (MSDS) shall be		Prior to commencement

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		available on site for all relevant chemicals Any area used to store Hazardous Chemicals (including fuels, paints, bitumen, lubricants, etc.) must be bunded with an impermeable liner to protect soil and ground water contamination. A Materials & Hazardous Substances plan must be developed by the Contractor prior to site establishment		
Municipal Service Infrastructure	Ensure all related service infrastructure has been identified & protected.	Survey and mark out Eskom Powerlines, Water Pipes, Sewer Pipes, Gas Pipes, Storm Water Pipes and related infrastructure	RP / SE	Prior to commencement
Storm Water Management / Erosion	Ensure that adequate provision is made for storm water run-off from the site to erosion, siltation and sedimentation	Draw up a Storm Water Management plan for the site taking into consideration the gradient and road alignments. Include the use of Sustainable Urban Drainage measures into the SWM The storm water system must be kept separate from the waste water system Drainage from the site must be adequately controlled and directed to ensure that run off will not give rise to off site pollution or result in damage to properties downslope of the site. The SWMP must be approved by relevant departments (DWS and Alfred Duma Local Municipality.	RP / SE	Prior to commencement
Top Soil	Ensure that top soil is re-used on site	Collect the top 15 - 30cm of soil on the site for use as top soil during landscaping Ensure top soil is stockpiled in a suitable area away from adjacent properties Prevent run off from the stockpile washing into the road by using proper strategies to contain run off	RP / SE	Prior to commencement
Town Planning	Ensure that the proposed development has town planning approval	An application has already been lodged and is being considered by Town Planning Control Prepare an appropriate SDP (where prescribed) that includes the Fire Management Plan and Emergency	RP / Developer	Prior to commencement

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		Response Plan Comply to all relevant other approvals from Alfred Duma Local Municipality or other service providers		
Traffic Access	Ensure that the development layout and relevant requirements of the KZN Department of Roads and Transport have been complied to	Appoint an professional traffic engineer to obtain the relevant way leaves and permission to construct the access roads and intersections proposed by the Traffic Engineers Report	RP / Developer	Prior to commencement
Waste Management	Ensure the effective and efficient separation, storage and removal of waste from the site	Develop a Waste Disposal Management Plan for the construction phase which will detail: - Schedules for collection - Responsible parties for collection - Details regarding waste separation (hazardous vs. General) - Provision of facilities for the separation and storage of waste - Details regarding the disposal of the waste (hazardous and general) - Assigns responsibilities for these activities	RP / SE	Prior to commencement
Water Use License	Ensure that activities within or across water courses and/or wetlands are permitted prior to development	Appoint a professional to compile a water use license application for the relevant activities and developments within the water course. A WULA will be required for the alteration of the bed or banks of a water course, impeding the flow of water in a water course or construction infrastructure that may impact on a water course, development within 500m of a wetland, potential impact on the underlying aquifer or ground water zone and/or the storage of water. Compile a Sanitation Project Implementation plan that addresses the requirements as set by the DWS Arrange a Pre-Water Use License Application meeting to clarify the scope and approach to the WULA	RP / SE	Prior to commencement
PRE CONSTRUCTION (B)				
Complaints register	Ensure that all complaints, issues and	A complaints register must be kept on site.	C	Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
	concerns are recorded and fed back to relevant authorities. Ensure that Interested and Affected Parties are informed of the project schedules and date of construction start	Notify Interested and Affected Parties when construction activities commence.		At start of construction
Alien Plants (Eucalyptus & Black wattle)	Ensure that alien plants that occur on site are removed from site)	The exotic and alien plants (eucalyptus & black wattle) that occur on site must be removed by developing a work plan. This must include felling the trees, cutting up the branches and providing wood (where feasible) to the local community. Stumps must be removed by a stump chipper that returns the wood to the soil. Alternatively stumps must be treated to prevent coppicing and regrowth.	RP / SE	Prior to construction
Contractors Camp	Ensure that there is no unnecessary disturbance to areas on the site and that construction activities take environmental considerations into account Ensure that the contractor's camp does not pollute the environment Ensure that camp does not infringe on adjacent property owners	A layout plan for construction activities needs to be developed and approved by the Environmental Control Officer Staff facilities, ablutions, chemical toilets, potable water must be provided for the staff Locate the camp away from immediately adjacent property owners	C / SE	Prior to Construction
Cultural Environment	Ensure that cultural historic artefacts or features are not degraded or destroyed	All staff must be made aware that cultural historic resources may be uncovered in the construction process and must be equipped on how to deal with such a find. Confirmation of grave sites in the study area through a social consultation process that addresses the issue of unmarked graves associated with structures as well as stone cairns currently interpreted as possible graves; Graves located in future and known graves should ideally be retained *in situ* in open spaces; Implementation of a chance find procedure for the	RP / ECO	Monthly

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		project as outlined in Section 9.1; A Site development plan should be compiled for the development; Site specific recommendations should also be adhered to.		
Faunal & Flora could be displaced or harmed by construction activities	Ensure that natural areas are not degraded by the development	Do not locate the construction camp in or adjacent to sensitive habitats that include the water courses, wetlands, rocky areas and ecologically sensitive habitats. Ensure access paths, tracks and roads do not cross of impact negatively on ecologically sensitive areas All ecologically sensitive areas must be marked out to prevent access into these areas. This barricade must be maintained throughout the life of the construction period.	RP / ECO	Continuous
Fencing	Ensure site is secured and barricaded to prevent illegal access and limit liability	The construction camp must be secured with suitable fencing / barricading to prevent the public access as well as criminal activity.	C / SE	Continuous
Provision of services	Ensure that sanitary infrastructure is in place before construction starts.	Chemical toilets must be placed on site as well as water supply e.g. from an existing household or freestanding water tank.	C	Prior to construction
Storm Water runoff can wash silt and sediment off the site and erode the site	Ensure the proper management of storm water run off from the site so as to prevent erosion, localised flooding and siltation	Ensure that the site camp can drain to prevent surface water standing on in the camp Ensure berms or gabions are in place to collect and slow run off water Construct adequate silt traps to collect silt washing from the site Construct the attenuation ponds prior to clearing the site	C / SE	Prior to construction
Top Soil can be lost if not protected	Ensure preservation of the top soil Ensure that erosion impacts and siltation is kept under control	Top soil stockpiles must be established in disturbed zones and away from adjoining areas Areas scheduled for construction should be cleared only 1 week prior to construction	C	Prior to construction

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Training/Staff awareness	Improve the awareness of all construction personnel with regard to environmental matters	Develop and implement a training programme to address environmental issues and responsibilities	C / ECO	Prior to construction
Water Quality can be reduced by siltation and the discharge or spillage of chemicals	Ensure that run off water does not include any pollutants.	All storage areas that include hazardous materials must be bunded with an impermeable liner	C / SE	Prior to construction
CONSTRUCTION (C)				
Access Roads	Ensure that a dedicated access road is created and used to prevent unnecessary degradation of the roads ways	Create a dedicated entry/exit road to the site Regularly (daily) sweep the roads to remove sediment Heavy vehicles must not compact soils Flagmen must be used to control the movement of heavy vehicles to and from the site	C	Prior to construction Continuous Continuous Continuous
Cleaning of equipment	Ensure that spillages are minimised and that where these occur, that they are appropriately managed	Proper cleaning trays should be used for the cleaning of cement mixing and handling equipment A wash bay with sump / evaporation pond must be used to clean vehicles and prevent the run off of polluted wash water.	C	Continuous Continuous
Communication with IAPs	Ensure that interested and affected parties are provided with a medium through which to lay complaints with regard to activities on site	A complaints register should be kept in the site office. EDTEA needs to be informed of all complaints and corrective action must be taken where required. IAP's must be informed of disruptive activities within 24hr of planned date of commencement. Thus can include leaflets, sms or alternative forms such as email.	C	Continuous As and when received 24 hr notice before each event
Contaminated Soil	Ensure that soils that are contaminated do not pollute the environment	All soils that have been contaminated by fuel spills, paints spills, etc. Must be appropriately removed from the site, which must then be rehabilitated.	C	As and when required
Contractor's camp	Ensure that the contractor's camp is secure	All materials and equipment that can be moved must be stored overnight in the contractor's camp Chemical toilets must be regularly maintained and cleaned out weekly. Records must be kept on the frequency of clean ups and provided to ECO	C	Daily Continuous. Monthly

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		Drainage within the camp must be maintained to prevent standing water No showers are to be created within the camp unless these link with a sewer Rest Areas / Eating Area are to be regularly serviced to ensure for hygiene and cleanliness Bins/Plastic bags are to be created at each rest area Litter is to be cleaned up daily within the camp		Continuous Continuous Weekly Daily Daily
Cultural Historic Features	Ensure that all identified and/or discovered artefacts are protected and/or permitted prior to their destruction	If during the pre-construction phase, construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager. It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find, and confirm the extent of the work stoppage in that area. The senior on-site Manager will inform the ECO of the chance find and its immediate impact on operations. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.	C	Continuous
Disturbed Ground Conditions	Ensure that disturbed ground conditions are identified	Accurately locate the presence of disturbed ground conditions during installation of underground services and construction	C	Prior to construction
Dust	Ensure dust does not significantly pollute neighbouring properties	Wet all exposed sand areas such as roadways, stockpiles and working areas that give rise to dust. This must ensure adequate dust suppression especially during windy periods Vehicles travelling onto and across the site must maintain a maximum speed limit of 20km/hr	C	Daily where necessary As needed Daily

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		If dust is unavoidable, mist spays must be established on the boundary wall of the site No fires are permitted on site Vehicles must be serviced to prevent emissions into the atmosphere		As required Continuous Continuous
Ecological Impacts	Ensure that sensitive habitats are not negatively impacted upon or degraded by the construction activities	The west east running rocky outcrop as well as the rocky habitat in the western corner of the site must be allocated as open space where construction activities should actively be prevented and limited; A 15 meter buffer area should be created around these vegetation units to limit development related impacts on them; Before construction starts, these areas should be demarcated to prevent construction vehicles in these areas; The stream areas with associated buffer areas as well as existing eroded areas on the lower ends of the site should be kept free from development. This will allow not only for natural habitats, including streams and grasslands, to stay intact, but also to protect the areas against impacts and further degradation; Trenches cut for services, may not be left open over holiday periods to prevent small fauna to get trapped; The construction site must be screened for exotic invasive species on a regular basis, and such species appropriately removed if they appear; No heavy vehicles may cross stream areas without the necessary protective or formal structures in place; Noise and dust must be mitigated to limited such impact on the fauna and flora of the area; Open space areas may not be used for storage of construction material. Signage should be erected to indicate and educated on the purpose and nature of the open land; Landscaping efforts must aim to increase indigenous	C / ECO	Daily where necessary As needed Daily As required Continuous Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		species on site, which will require less water than exotic trees and subsequently less maintenance once established; Should any fauna be encountered on site during development, they must be appropriately relocated into the neighboring natural areas. Species that could be encountered are snakes and hedgehogs; Before construction starts, construction workers should be educated with regards to littering, animal trapping and veld fire prevention; Both the construction and the operational phases must include waste and litter management strategies to prevent impacts on the stream ecology and surrounding land in general; Both the construction and the operational phases must include storm water management strategies that address potential impacts on the site and stream ecology; An effluent and/or contaminated storm water management plan must be devised for the site and can include e.g. an oil/water separator, to ensure that runoff water does not pollute the streams; Invasions by exotic vegetation due to development, should be monitored and acted upon timeously.		
Effect of the EMP	Ensure that the EMP is enforced on all contractors	All contractors and subcontractors must be bound by the content and requirements in this EMP	C / SE / ECO	Continuous
Environmental Control Officer	Ensure that there is compliance with the EMP on site	An Environmental Control Officer may inspect the site at any time during the construction phase A mid-construction and post-construction report should be forwarded to EDTEA for their information	ECO	As required Mid Construction Post Construction
Fill Materials	Ensure the stability of fill materials	Fill materials must be compacted to the relevant densities	SE	Where necessary

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Ground Water	Prevent the contamination of groundwater resources	Vehicles must be equipped with drip trays to prevent spillages of oils and fuels. All tankage and associated equipment must be constructed as per relevant SANS standards. Leak detectors must also be installed. All fuel spillages on site must be addressed immediately. Filler points and tank manholes must be fitted with secondary containment measures to ensure that any tank overfills are contained. Concrete containment slabs must be constructed around filler points and the dispending area.	C	Daily Continuous Continuous When required Continuous Continuous
Installation of Services	Ensure that all points for water provision are regularly inspected for erosion impacts Ensure that water used to wash machinery and any other "grey" water does not pollute the site	Implement adequate mitigating measures to curtail any erosion impacts Provide a wash bay with a concrete floor to contain such grey water. This water must accumulate into an evaporation pond or oil separator	C	Continuous Continuous Continuous
Litter	Ensure that the site remains clean and clear of litter	All litter must be collected into rubbish bins located on the site. These bins must be regularly (i.e. weekly) collected and transported to a registered waste disposal facility.	C	Daily Weekly
Loss of faunal species	The capture or hunting of any fauna on the site is not permitted	Should any fauna such as hedgehogs be encountered on site during development, they must be carefully relocated into the neighbouring natural grassland areas.	C	Continuous
Noise	Ensure that nuisance noise from construction activities does not disrupt the surrounding landowners	Limit construction time to the following hours: 06:00 to 18:00 during week; 07:00 to 15:00 on Saturdays, and no noisy activities on Sundays Jack hammering and blasting, if required, must take place between the hours of 08:00 and 17:00 during the week only No heavy vehicles may be permitted to move on site outside of work hours	C	Daily Daily Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Paleontological Features	Ensure that all identified and/or discovered artefacts are protected and/or permitted prior to their destruction	The following procedure is only required if fossils are seen on the surface and when excavations commence. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, wood, bone, coal) should be put aside in a suitably protected place. This way the building activities will not be interrupted. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 4, 5). This information will be built into the EMP's training and awareness plan and procedures. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment. If there is any possible fossil material found by the developer/environmental officer/engineers then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits. If no good fossil material is recovered then the site inspections by the palaeontologist will not be necessary. Annual reports by the palaeontologist must be sent to SAHRA. If no fossils are found and the excavations have finished then no further monitoring is required.	C	Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Road Works and Traffic	Ensure that soil does not erode from culverts or similar structures	All culverts or similar structures must be stabilised with gabions and/or indigenous grasses The movement of heavy vehicles from the site must occur outside of peak traffic hours (after 08h30 and before 16h30 each work day) Spillages on the roads should be avoided. When these occur, they should be cleaned immediately Notices should be placed at relevant locations during the construction period indicating that heavy vehicles are using the road	SE	Continuous Daily Continuous Daily Daily where relevant
Safety & Security	Ensure the safety and security of staff and the public	All local authority by-laws must be adhered to All contractors must take cognisance of and abide by the Occupational Health and Safety Act (1993) Trenches to a depth greater than 1.5 m must be supported or appropriate warning must be provided Provided fencing needs to be checked and maintained The movement of construction workers through the residential area should be restricted wherever possible	C	Continuous Continuous Continuous Weekly Continuous
Site Safety	Ensure that all staff, visitors and people on site comply to the OHAS to promote a safe working environment	All people that visit the site or work on the site must comply to the OHAS Act (as amended). A SHE officer must be appointed to manage occupational safety on site A professional must be appointed to audit compliance to the OHAS Act All people on site must wear appropriate PPE All areas that pose a fall risk must be adequately barricaded with danger tape	C / RP	Continuous Pre Construction Continuous Continuous Continuous
Soil	Ensure that storm water can not erode the top soil stockpile	Construct and maintain a berm around top soil stockpiles Maintain adequate berms, gabions, bayles of hay, sand bags on the site to control storm water run off and minimize erosion	C	Continuous Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Staff Communication & Training	Ensure that staff are regularly updated and understand environmental issues on the site	The ECO / SHE officer must regularly update the staff of the environmental issues on site and in the surrounding area Records for the various meetings and training must be kept	ECO / SHE / SE	Monthly Monthly
Storage Facilities	Ensure that hazardous materials are stored according to legislative requirements	Specifically designed storage facilities need to be provided and used for hazardous materials. Fuels stored on site shall be bunded to 110% of the capacity of the largest container The fuel storage area must not be located less than 50m from any water resource Cleaning of cement mixing and handling equipment shall be done using proper cleaning trays and all cement containers should be removed from the site for appropriate disposal at a licensed commercial facility.		Continuous Continuous Continuous Daily
Storm Water Management / Erosion / Local Flooding	Ensure that storm water run off does not pollute the environment or erode the site	Construct a temporary attenuation pond or adequate berms and gabions to contain storm water runoff during the construction period. Ensure that storm water can drain freely from the site. Use a line of secured bayles of hay (along the foot of the site) to prevent silt entering the road reserve and drainage channels.	SE / C SE / C SE / C	Continuous Continuous Continuous
Storm Water Run-off	Ensure that run-off does not contribute to erosion & siltation	Construct and maintain berms on the site to contain storm water run-off or establish riffle beds or retention ponds, as appropriate	C	Continuous
Surface water	Ensure the use of legal water sources needed for construction and other water uses	No water may illegally be pumped out of nearby rivers for construction or other water needs associated with the project.	C	Continuous
Vehicles and vehicle repairs	Ensure that spillages are minimised and that where these occur, that they are appropriately managed	Minor vehicle repairs on an appropriate work surface may take place in the contractors camp Vehicles should be equipped with drip trays to prevent oil and fuel spillages	C	Continuous Daily
Visual Character	Ensure that the development on site does	Lighting on site must not disturb the adjacent	C / SE	Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
	not detract from the character of the area	properties All lighting must be focused downward and away from oncoming traffic and nearby houses The site must be screened off from the surrounds by the construction of the boundary wall or the erection of a barrier screen.		Continuous Continuous
Visuals & Aesthetics	Ensure that the visual aspects of construction are taken into consideration to lessen impacts on residential, business and social amenities in the area.	Screen construction areas with shade cloth or other suitable material from adjacent properties.	SE / C	Continuous
Waste	Ensure the adequate removal of solid waste	All wastes (hazardous or general) must be collected and disposed of at an appropriate registered facility. Nets need to be provided over bins and skips should windy conditions prevail No waste should be burnt on site	C	Continuous Daily during windy periods Continuous
Waste Management	Ensure that waste on the site does not pollute the environment or degrade the site	A waste skip must be kept within the contractors camp. The skip must be regularly emptied Records must be provided to the ECO No waste may be permitted to accumulate on site No waste materials may be permitted to blow from the site due to wind. Screens and netting must be used to contain paper and plastics Waste Bins / Plastic bags must be located across the site work area for staff to dispose rubbish into Littering on site is forbidden and the site cleaned each day Recycling is to be encouraged by providing separate receptacles in the contractors camp	C	Continuous Weekly or as required Monthly Continuous Continuous Continuous Continuous Continuous Continuous
Water Quality	Ensure that the surface water quality is not degraded by activities on site	The mixing of materials such as concrete and cement must occur on an impermeable surface All hazardous chemicals/materials must be stored	C	Daily Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		under cover and on an impermeable surface A grey water evaporation pond must be created that has an impermeable floor No contaminated water may be discharged or pumped into the sewer or storm water system A designated area must be used for concrete wash from the concrete trucks. This must be bermed and contained to prevent run off washing cement and concrete off site		Continuous Continuous Continuous Continuous
Wetland and Water Course habitat	Ensure that the water course and wetland habitat is not negetaively impacted upon or degraded by construction activities.	No temporary accommodation or temporary storage sites to be erected within 100m of the any watercourse (including wetlands, drainage lines and dams). No excess imported soils or stone (if used during the construction phase) may be left behind. These materials to be removed on completion of the project. Disturbed surface areas in the construction phase to be rehabilitated. Only locally indigenous grasses to be used in the rehabilitation plan. All hazardous materials such as but not limited to paint, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the terrestrial and water environments. All construction material, equipment and any foreign objects brought into the area by contractors and staff to be removed immediately after completion of construction. Removal of all waste construction material to an approved waste disposal site. A site-specific storm water management plan is required. A site-specific rehabilitation plan of watercourses is required. Aquatic monitoring is required by an independent specialist during the construction phase of the project.	C / ECO	Continouois

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Wet Wastes	Ensure that no wet waste is disposed of down drains, sewers, etc.	No wet wastes or solvents shall be permitted to be disposed of down sewers, drains or storm water drains Non-ferrous metal pipes or plastic pipes must be used for the wet services	C	Continuous Continuous
POST CONSTRUCTION (D)				
Alien Plants	Ensure that alien invasive plants are removed from site	The site must be cleared of all alien invasive species	C	Post Construction
Contractors Camp	Ensure that the site is left clean, orderly and all materials and equipment removed	All structures, infrastructure and materials must be removed from the site Any soils that were contaminated by the activities in the camp site must be rehabilitated either on site or by removal to a registered waste disposal site All hardened surfaces must be ripped and hydroseeded if the area is remain unused All waste and litter is to be removed to a registered waste disposal site Records for the relevant disposal of materials must be presented to the ECO prior to issuing a closure report	C / SE / ECO	Post Construction
Sidewalk Rehabilitation	Ensure that the sidewalks are left clean, orderly and free of rubble after construction activities	Rehabilitate disturbed sidewalks; remove all rubble, rubbish, litter or any other relevant articles from the sidewalks	C	Post Construction
Site Rehabilitation	Ensure the site is left clean, orderly and free of rubble after construction activities	Remove all rubble, rubbish, litter, unused building equipment, contaminated soils or any other relevant articles from the site following the end of the construction phase Hydroseeed all areas that will not be developed and/or landscaped The relevant areas must be regularly watered (twice per week) to promote the successful re-establishment of grass cover on the site	C	Post Construction Bi weekly
Site walkabout	Ensure that all relevant Environmental Management Measures and actions have been implemented by the Contractor / Site Engineer	A site walkabout must be undertaken by the ECO, Contractor and Site Engineer, prior to final hand over of the site, ensure all relevant actions have been implemented	ECO / SE / C	Prior to site hand over

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Soil	Promote the rehabilitation of the site back to its original condition as far as possible	Soil that has been compacted during construction activities must be ripped in two perpendicular directions Top soil that is stockpiled on site must be used to rehabilitate the disturbed areas	C	Post Construction
OPERATIONAL (E) INCLUDING EMERGENCY AND CONTINGENCY MEASURES				
Emergency Situations that include Explosion, Heavy Vehicle accidents, Terrorist Attacks, Flooding).	Ensure the safety, well-being and protection of people and property	Implement a training system that equips relevant staff with knowledge of the correct procedures to be followed in the unlikely event of an emergency situation or incident; Immediately attempt to contain any damage and ensure the safety of persons on site. This will include making use of fire & rescue equipment and keeping people away from any dangerous situations; Instruct all people and staff on the site to collect in the Emergency Assembly Point that has been identified on the site. This must be away from buildings and close to an access point (i.e. in the main parking area); Immediately contact the relevant emergency departments including – the SAPS, Alfred Duma Local Municipality Immediately inform the adjacent neighbours of any situation that may endanger the people or property of these land owners.	Emergency Response Crew/Personnel	Continuous and in the unlikely event of an emergency situation
Ecological Impacts	Ensure that the open spaces and ecological habitats are note degraded by community activities	During the *operational phase*, the open spaces must be demarcated and educational information signage provided to indicate the value and purpose of these areas; Educational sessions should be provided by community centers on sustainable use of resources	Developer	Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		in open spaces;		
Fire Risk	Ensure that the public garage does not endanger the life or property of adjoining land owners	The Fire Management Plan must be implemented for the site Adequate personnel must be trained to implement and manage the Fire Management Plan	Developer	Continuous Continuous
Ground water contamination by VIP latrine spillage	Ensure that the sewage pit latrine does not overspill, leak or contaminate the soils	Annually ensure that all pits on the development site are treated with an adequate does of Sannitree Bioenzyme granules that assist in reducing the sludge volume Sanitation facilities should be well maintained and serviced regularly, any breakages or leaks should be fixed immediately to prevent loss of containment Implement the Sanitation Project Implementation Plan that includes use of monitoring boreholes, testing surface and ground water quality and an assessment of risks to the ground water environment. Ensure no pits are located within the 1:100 year flood line	Developer	Continuous
Monitoring Wells	Ensure that risk of potential spills and/or leaks are minimised and/or prevented	The recommendations of the Geohydrological Assessment must be implemented for the site. Additional groundwater monitoring boreholes should be drilled once the development is in operation to develop the groundwater monitoring network.	RP / SE	Prior to commissioning Prior to commissioning Daily Weekly Prior to commissioning

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
Noise	Ensure site activities do not give rise to nuisance noise	Activities that give rise to noise (such as loud music, vehicle repairs, air conditioners, car wash activities, public gatherings, etc.) must not be permitted to give rise to nuisance noise impacts. The times for noisy activities must be limited to normal work times.	Developer	Daily Daily
Spill Contingency Plan	Ensure that unforeseen spills are contained and rehabilitated so that the soils and aquifer is not degraded by activities on site	In the unlikely event of a major spillage or leakage, an appropriate spill response and clean up contractor must be contacted immediately to assist in clean up operations. A spill control kit must be established on site. Appropriate personnel must be equipped to operate the spill kit Spillages occurring at the filler point and dispensing area must be contained and cleaned up immediately. Any water containing waste generated as a result of the spillage and associated clean up must be disposed of safely and in accordance with the NEMA Waste Act or relevant environmental legislation. No product or waste may be allowed to be discharged into a municipal storm water or sewer system or into the surrounding environment The following Action Plan is proposed for an unforeseen spill – • Stop the spill at source (where possible) • Contain the spill • Report the spill to the Site Manager • Contact a suitably qualified company/professional to assist with containment, collection and treatment of the spill and affected areas • Rehabilitate the spill in situ or remove contaminated materials for off site disposal at a registered waste disposal company or treatment	RP	Upon detection Continuous Monthly Upon detection Continuous Continuous Continuous

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		• Contact the relevant authorities in the event of a significant spill (more than 100 litres) • Record the event and steps taken to manage the spill • Reconcile the volume of material lost in the spill		
Waste / Litter	Ensure that the site remains free of litter and that no waste accumulates on site	Provide an adequate number of bins across the site that can be used to dispose litter Domestic waste must be regularly removed from site (at least once per week)	Developer	Continuous Weekly
Wetland and Water Courses	Ensure that the wetland and water courses habitats remain functional and are not degraded by the community	Mechanical control and monitoring of alien plants around disturbed areas to be implemented. No chemical control (herbicides) of alien plants to be used within 100m of any watercourses. Herbicides could get into the water system and will have a detrimental effect on the environment. Rehabilitated areas to be assessed and corrected where necessary. Potential erosion areas to be inspected and corrected or rehabilitated where necessary. Special attention must be given steep areas where erosion and gully formation can have direct impacts on the streams, dam and other watercourses in the study area.	Developer	Continuous
COMPLIANCE / MONITORING / MANAGEMENT				
Site Inspections	Ensure regular visits to the site by relevant parties to capture and record issues, impacts and measures to manage the environment	A compulsory monthly site inspection must be undertaken by the ECO, SE, C and other relevant professionals and parties to inspect the works and record issues of concern	ECO / SE / C / RP	Monthly during Pre Construction / construction / Post Construction (and or where relevant)
Monitoring Reports	Ensure that environmental performance is recorded and measured	A monthly Monitoring Report (including photos and adequate plans and records of site activities) must be	ECO	Monthly

Environmental Impact / Aspect	Impact Management Objective	Management Action	Responsibility	Frequency / Timing
		provided to record environmental performance for past, current and future environmental matters		
Internal Audit Report	Ensure that the SE records, measures and complies to environmental management requirements including this EMP and any other requirements	An internal Environmental Audit Report must be prepared by the Site Engineer to track environmental performance	SEO	Monthly during Pre Construction / Construction and Post Construction (and or where relevant)
Internal Audits	Ensure that environmental management occurs on a daily basis by a suitably qualified person(s) that are trained, equipped and able to address environmental queries, issues, concerns and impacts	Appoint a qualified Environmental Officer that will be responsible for the environmental management on site Compile weekly monitoring reports Include the weekly monitoring reports into the monthly Internal Audit Report	SE SEO SEO	Upon Commencement Weekly Monthly

6.7 Rehabilitation Plan for Eroded / Dispersive Soils

Rehabilitation action	Activities
1. Landscape disturbed areas and prepare soils	Areas that have been allocated as open spaces need to be levelled as per the landscape plan and the soils prepared for the necessary rehabilitation; Topsoil that was conserved, can be used here to save costs and to allow local seeds back into the soil.
2. Establish vegetation	It is unlikely that disturbed areas will naturally re-vegetate and therefore a predominantly indigenous grass mix is suggested for rehabilitation purposes. Grass species such as *Chloris gayana, Cynodon dacylon, Cenchrus ciliarus, Digitaria eriantha* and *Eragrostis curvula* are known to establish fast on disturbed areas. Soil should be loose enough to accommodate seed germination; Mulching* should be used for rehabilitation (* packing of indigenous grasses from the area on exposed soil to stabilize soil and allow for seeds to germinate); Mulching: Thatch grass can be placed over the exposed soil of the closed trench to limit erosion. “Soil saver” or similar product must be used to improve rehabilitation results.

	 Indigenous trees should be used for tree planting and can include species such as *Celtis africana, Combretum erythrophyllum, Rhus lancea, Rhus pyroides* and *Acacia karroo.*
3. Maintain until stabilized	An inspection programme must be compiled with the help of an ECO. Any erosion or wash always that occurs after re-vegetation, must be backfilled and consolidated and restored to a proper stable condition. A weekly inspection of rehabilitated areas is suggested initially, there-after a bi-monthly inspection if vegetation has established. Ultimately, rehabilitated areas must be maintained for at least 3 years.

6.8 Preliminary Design Criteria for the Access Roads & Low Water Bridge

The design should ensure that the following preliminary criteria are met to ensure the ongoing functioning of the various zones of the wetland in the vicinity of the crossing.
The table below presents the objectives for conservation of the wetland feature as well as the areas upstream and downstream of the crossing. The table also presents the design criteria required in order to meet these requirements.
The design of the crossing structure (bridge and access road) over the wetland must ensure that the on going functioning of the wetland is facilitated with specific mention of the following –

- Ensure the hydraulic connectivity of the wetland areas is maintained between upstream and downstream areas of the bridge;
- Ensure that permanent, seasonal and temporary wetland zone functionality is marinated through provision of measures to ensure that soil wetting conditions area maintained;
- Ensure on going functioning of the wetland areas in the vicinity of the crossing;
- Ensure that the bridge design allows for wetland soil conditions to be maintained both upstream and downstream of the bridge to such a degree that wetland vegetation community structures upstream and downstream of the crossing are maintained in their Present Ecological State;
- Ensure that no incision and canalization of the wetland system takes place as a result of the construction of the crossing structure;
- Ensure that migratory connectivity for more mobile faunal species is facilitated to allow movement of these species between areas upstream and downstream of the crossing.

Table 25. Watercourse Objectives

Objective	Preliminary Design Criteria
Ensure that hydraulic connectivity of the wetland areas is maintained between the areas upstream and downstream of the crossing	The design must ensure that the soils in the valley bottom wetland zones remain inundated with water after heavy rainfall events. In order to achieve this, the following should be implemented – • The pioneer layer should be constructed out of a porous material or form material which is coarse enough to assist with the movement of water through the structure to allow wetting of the soils to occur on the downstream side of the crossing • The extent to which culverts are used in the system should reach as far as is possible to ensure that during freshets the broadest possible area becomes inundated allowing the recharge of the wetland soils • The design should ensure that the seasonal wetland zone should have water logged soils within 300mm of the soil surface at all times • Temporary wetland zone areas should have waterlogged soil conditions occurring to within 300mm of the land surface during the summer season

Ensure that permanent, seasonal and temporary wetland zone functionality is maintained through provision of measures to ensure that soil wetting conditions are maintained	• The pioneer layer should ensure that soil wetness is maintained in the upper 300mm throughout the extent of the valley bottom wetland on the downstream side in order to ensure that facultative and obligate wetland vegetation species can still be supported • The pioneer layer should be constructed out of a porous material or form material which is coarse enough to assist with the movement of water through the structure to allow wetting of the soils to occur on the downstream side of the crossing • The structures to be used for the crossing should be spaced across the wetland system in such a way as to ensure that wetness and waterlogged soil conditions persist in the permanent wetland zone at all times. The design should allow for the seasonal wetland zone to be inundated and soil to become waterlogged on a seasonal basis through ensuring that Armco Pipes allow water to reach these areas during large rainstorm events. The temporary wetland zone under the 1:100 year floodline should become inundated and waterlogged soil conditions should occur from time to time and after large rainfall events. Culverts or similar structures which may be of smaller diameter than the larger pipes in the seasonal and temporary wetland zones should allow water to flow through the crossing structure during the largest rainfall events. • The bridge design must limit the degree of upstream ponding which occurs. Ponding should only occur for a very short period (a few hours) after heavy rainfall events
Ensure ongoing functioning of the wetland areas in the vicinity of the crossing	• All effort to prevent contamination of the wetland areas must occur. In this regard special mention is made of the need to service and refuel all vehicles off site • The footprint of the crossing structure should remain as small as possible • All materials used to construct the crossing structure should not generate toxic leachates or lead to significant changes in pH or dissolved salt concentrations. In this regard, pH should not change by more than 5% between upstream and downstream areas and the TDS value should not increase by more than 10%

	• As far as possible, all construction activities should occur in the low flow season • All rock and rubble which remains after the construction needs to be removed from the wetland area prior to the contractors leaving the site
Ensure that the bridge design allows for the wetland soil conditions to be maintained bith upstream and downstream of the bridge to such a degree that wetland vegetation community structures upstream and downstream of the crossing are maintained	• The design should ensure that the permanent wetland zone should have inundated soil conditions throughout the year extending the soil surface • The design should ensure that the season wetland zone should have water logged soils within 300mm of the soil surface at all times • Temporary wetland zone areas should have water logged soils conditions occurring to within 300mm of the land surface during the summer season
Ensure that no incision and canalization of the wetland system takes place as a result of the construction of the bridge	• The crossing structure must allow for sufficient dispersion of water through the wetland area to prevent the concentration of flow in the permanent zone or the active channel which could lead to scouring and incision of the system • During construction the footprint areas of the construction activities must be kept to a minimum. All vehicles must use one single designated track and turn-around areas should be located outside of the wetland boundary • Any areas of disturbed soils where vegetation removal has occurred need to be re-vegetated to prevent erosion and sedimentation
Ensure that no erosion or sedimentation occurs	• The bridge walls are to be clad with rock or re-vegetated to prevent erosion • Any areas of disturbed soils where vegetation removal has occurred need to be re-vegetated to prevent erosion and sedimentation • The pioneer layer used to construct the bridge will be extended in a downstream direction which will ensure protection of the stream from erosion
Ensure that migratory connectivity for more mobile faunal species is facilitated to allow movement of these species between areas upstream and downstream of the crossing	• The design must ensure the free movement of all smaller faunal species • The bridge structures to be used for the crossing should be spaced across the wetland system in such a way as to ensure that wetness and waterlogged soil conditions persist in the permanent wetland zones at all times. The design should allow for the seasonal wetland

	zone to be inundated and soils to become waterlogged on a season basis through ensuring that the culverts or other structures to be used allow water to reach these areas during the larger storm events. The temporary wetland zone under the 1:100 year floodline should become inundated and waterlogged soil conditions should occur from time to time after large rainfall events. Culverts or other structures, which may be of smaller diameter than the larger pipes in ther seasonal and temporary wetland zones should allow water to flow through the crossing structure during the largest rainfall events.

6.9 Conclusion

Based on the findings of the EMP Report and various specialist studies that were conducted for the proposed development it can be concluded that the Preferred Layout - Alternative 1 (Figure 6) would not have any significant environmental impacts that would make the development environmentally and socially unsustainable.

Should the prescribed mitigation measures (as specified in the EMPr) proposed for the development be adhered to, then it is not foreseen that the proposed development will have any detrimental effects on the environment.

For the above mentioned reasons, the proposed development is recommended for approval.

Report Compiled by

Mr Mark Custers (Pr. Sci. Nat.)
for Eco Assessments

SECTION SEVEN - APPENDICES

Appendix A1
Approval of Final Scoping Report & Plan of Study for EIA

Appendix A2
Extension to Lodge Final EIA Report

Appendix B
Qualification of EAP

Appendix C
Town Planning Memorandum

Appendix D
Civil Services Scheme Report

Appendix E
Storm Water Management Plan Report

Appendix F
Traffic Impact Assessment

Appendix G
Electrical Services Scheme Report

Appendix H
Geotechnical Assessment Report

Appendix I
Ecological Assessment Report

Appendix J
Wetland Delineation & Assessment Report

Appendix K1
Heritage Impact Assessment Report

Appendix K2
Paleontological Report

Appendix L
Geohydrological Assessment Report

Appendix M1
Cost Benefit Analysis for Alternative Sewer Types

Appendix M2
Ventilated Improved Pit Latrine Toilet Design

Appendix N
Proof for the Circulation of the Daft EIA Report to IAP's & State Departments

Appendix O
Specialist Declaration Forms

Appendix P
Comments from IAP's on the Draft EIAR