

Appendix F
Environmental Management Programme (EMP)

**ENVIRONMENTAL MANAGEMENT PROGRAMME
(EMP)**

for

**THE NEMA SECTION 24G RECTIFICATION OF DE BROUGH
ESTATE ON PORTION 172, PORTION 534, 535, 536 AND 537 OF
THE FARM WATERKLOOF 305 JQ, RUSTENBURG, NORTH WEST
PROVINCE**

REC 02/2013NW

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October 2013

1. INTRODUCTION

HydroScience cc, an independent Environmental Assessment Practitioner (EAP), has been appointed by Mr Alec Brough, representing the Brough Family, to submit a Section 24G application for the rectification of the unlawful commencement and continuation of activities listed in terms of Government Notice Regulation (GNR) (GNR 544 Activity 9, 22, 23; GNR 545 Activity 5; GNR 546 Activities 4 (c) (i) (gg)) of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998), as amended and the Environmental Impact Assessment (EIA) Regulations of 2010. The project relates to the township establishment on remaining extent of Portion 172, Portions 534, 535, 536 and 537 of the farm Waterkloof 305 JQ located in Rustenburg in the North West Province.

The properties cover 13.8135 Ha in total and the entire area has been disturbed due to the development. Approximately 6 Ha has already been built on and is occupied. Some buildings were demolished by the municipality. The facility can accommodate up to 200 families (600 people). The homes consist of different construction materials including brick, pre-cast walling and wood. There is a secure entrance (restricted access gate) from the R24/R30 (P16-1) in the southern and northern corners of the site. The entire property is bordered by a single layer brick wall and an internal gravel road network exists on the property for travel. There is a private home (belonging to the Brough family) on site along with an office for assistance to residents. The development includes a community centre (also used as a church) for the residents. A section on the western boundary of the site serves as grazing facilities for cattle. No other agricultural activities exist on site.

Water supply: Water is sourced from the groundwater resource via four (4) boreholes located on the site. There is a servitude registered on the property to supply neighbouring properties with water from these boreholes and the irrigation canal from the Olifantsnek Irrigation Scheme runs on the northern border of the property. Municipal water supply services do not extend to the property. A Section 21(a) water use licence application in terms of the National Water Act (NWA), 1998 (Act 36 of 1998) and/or registration as a water services provider in terms of the Water Services Act, 1997 (Act 108 of 1997) will probably be required for the use and supply of groundwater.

Sewage: A sewage treatment facility also exists on site since municipal sewage management infrastructure and services do not extend to the property. The sewage treatment facility will require a Waste Management Licence (WML) in terms of the National Environmental Management Waste Act, 2008 (Act 59 of 2008). The sewage treatment system includes both an aerobic and anaerobic process that has been self-engineered. The treated sewage water is recycled and utilised to water the De Brough Estate gardens.

Electricity: Municipal electricity exists on the site and generators have been installed for power outages. The water for ablution facilities is solar heated and gas geysers and stoves have been installed in the larger residential units to save of electricity.

Waste: Waste is collected and stored on-site in wheelie bins, bags or drums. The waste is collected by a contractor for off-site disposal. Waste recycling is also practiced.

1.1 Objectives

The purpose of the Environmental Management Programme or EMP (this document) is to ensure that undue or reasonably avoidable adverse impacts of the project are prevented, that impacts which cannot be prevented are managed to reduce their significance and that the positive benefits of the project are enhanced.

The EMP will therefore:

- Define the various measures to be taken during the life of the project (reconstruction and operation) in order to enhance positive and minimise/reduce adverse environmental impacts and meet the performance specifications;
- Define the actions needed to implement these measures;
- Describe how this will be achieved; and
- Allocate responsibilities.

EMPs are important tools for ensuring that the management actions/measures, arising from the impacts identified, are clearly defined and implemented through all phases of the project.

2. POTENTIAL IMPACTS AND MANAGEMENT MEASURES

As part of the EMP, the identified environmental impacts that occur result from the operation of the project. Their risks or potential impacts, the proposed management measures thereof and associated time frames are summarised in Table 1 below.

Phases of the project include:

- **Reconstruction phase:** This phase is required as mitigation to ensure buildings (houses/units) on the De Brough Estate complies with building regulations and an approved building plan.
- **Operational phase:** This is the current phase which will continue throughout and after the re-construction phase. There is no decommissioning phase as the project will continue indefinitely, unless the project is not approved.

2.1 Documentation

A copy of the EMP and any environmental authorisation issued as a result of this process should be kept on the site and made available to any authority/government official visiting the site for inspections and/or requesting a copy thereof.

2.2 Responsibility

The applicant will be responsible for the implementation of all mitigation and management measures as well as the compliance with this EMP during the operational phase if the activity is authorised. If the project is not approved and has to be decommissioned, the applicant will also be responsible for the associated rehabilitation.

The applicant may delegate his responsibilities to the Construction Contractor during the re-construction phase. Each Contractor involved in the project will comply with the EMP and will therefore appoint a Contractor's Representative (the title may vary), who is responsible for the on-site implementation of the EMP (or relevant sections of the EMP).

The Contractor will ensure that the Contractor's Representative is suitably qualified to perform the necessary tasks and is appointed at a level such that he/she can interact effectively with other site contractors, labourers, the Environmental Control Officer (ECO) and the public. The Contractor's Representative ensures that all sub-contractors working under the Contractor abide by the requirements of the EMP.

The conditions of the environmental authorisation and EMP must be brought to the attention of all persons (employees, workers, consultants, contractors etc.) associated with the undertaking of these activities and the applicant must take such measures that are

necessary to bind such persons to the conditions thereof (contracts with penalties for non-compliances).

2.3 Compliance monitoring & reporting

Accurate and up-to-date records will be kept of all system malfunctions or environmental incidents resulting in non-compliance with the EMP. The applicant will also, within 24 hours, ensure that the relevant authorities are notified of the occurrence or detection of any incident which has the potential to cause, or has caused pollution of the environment, health risks or which is a contravention of any EMP or environmental authorisation condition. The applicant is then to submit an action plan indicating measures which will be taken to:

- Correct the impacts resulting from the incident;
- Prevent the incident from causing any further impact; and
- Prevent a recurrence of a similar incident.



A complaints register will be kept on site throughout the project lifetime and all complaints from the public or residents will be noted therein as well as measures taken to rectify the situation as described above.


2.4 Alterations to the EMP

As EMPs should remain dynamic and flexible, certain conditions may require the EMP to be revised. These conditions may include the following:


- Changes in legislation;
- Occurrence of unanticipated impacts or impacts of greater significance, intensity and extent than predicted;
- Inadequate mitigation, i.e. where the level of an environmental parameter is not conforming to the required level despite the implementation of measures; and
- Secondary impacts which occur as a result of the mitigation.

Table 1: Identified potential impacts and proposed mitigation/management measures

Re-construction phase	
Flora & fauna	
Potential impact:	<p><u>Exotic/invasive species</u></p> <p>Current exotic and invasive species will need to be removed as to improve the current ecological integrity. The majority of the trees included exotic species <i>Pinus</i> sp. (Pine tree) and <i>Grevillea robusta</i> (Silky Oak). The Silky Oak specifically causes allergic reaction similar to that of Poison Ivy. Further, its root system is intrusive and will damage underground pipes (borehole servititudes, water pipelines).</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Pine trees</p> </div> <div style="text-align: center;">  <p>Silky Oak</p> </div> </div> <p><u>Edge effect</u></p> <p>The edge effect is already noticeable on site as the encroachment of exotic/invasive species from disturbed areas into the surrounding community. Exotics must be removed and at all times the reconstruction and operational activities must remain within the project area, no activities or signs of activities may extend outside of the project area boundary.</p>

	
	<p style="text-align: center;">Exotics on the project boundary</p> <p>Where alien invasive plants occur, as identified by CARA, 1983 (Act 43 of 1983), these will be required to be uprooted, cut and/or treated (use only approved chemicals as suggested by DAFF). The construction contractor's representative will only appoint a registered weed control officer to chemically treat any invader species. Care must be taken to avoid the spread of seeds of alien vegetation. No further indigenous vegetation may be removed.</p> <p>Further mitigation include:</p> <ul style="list-style-type: none"> • Remain within demarcated areas during all phases of the project to limit disturbances to surrounding areas and neighbouring properties; • Limit construction activities to the day time and working hours for the purpose of not disturbing activities and ecological processes of nocturnal birds, small mammal etc.; • Put a Waste Management Plan in place to prevent pollution of the site or surrounding ecology thereby further reducing the ecological integrity; • Limit dust on site and the spread thereof to surrounding vegetation through dust suppression; • Any open space must be re-vegetated with indigenous species of grasses and trees which will also promote the re-establishment of avifaunal species and prevent soil erosion; and • No animals (including snakes) may be killed or snared during construction. <p>Management Measures:</p>

Soil	
Potential impact:	<p><u>Soil erosion and pollution</u></p> <p>The removal of vegetation and current infrastructure will result in the exposure of the soil surface and therefore erosion can possibly occur during rainfall events. The rubble from demolition and reconstruction activities can further result in soil pollution.</p>
Management Measures:	<p>To reduce the likelihood of exposed soils being eroded by surface runoff, reconstruction activities should be limited to the dry season when the probability of rainfall events is very low. All areas stripped of vegetation during construction and not destined to be covered by hard surfaces (buildings, roads etc.) should be re-vegetated with appropriate indigenous ground cover as quick as possible at the close of reconstruction. Any surface runoff must be managed according to a storm water management plan if construction should take place in the wet season. All debris/rubble/waste must be disposed of according to a waste management plan. No littering may occur on site and litter clean-up must occur on a daily basis.</p>
Visual	
Potential impact:	<p><u>Loss of aesthetic value</u></p> <p>Due to the fact that the complete project area is walled in, the current visual impact is minimal, however during the reconstruction phase the boundary wall will be required to be moved and upgraded according to building regulations and the upgrade of the R24 which would expose the inner working of the De Brough Estate.</p>

	 <p style="text-align: center;">Boundary wall around De Brough Estate</p>
<p>Management Measures:</p>	<p>Due to the fact that the R24 (P16-1) will be broadened over the current De Brough boundary wall with the road upgrades planned, this wall will have to be removed. It is therefore, suggested that a new upgraded wall according to building regulations and NHBRC standards is developed behind the existing outer wall, so that when the outer wall is demolished, the new wall will already be established and be visible resulting in the De Brough Estate not being visible from the public access road.</p>
<p>Surface and Groundwater</p>	
<p>Potential impact:</p>	<p><u>Incorrect handling and spillage of building materials and hydrocarbons</u></p> <p>Spillage of building aggregate (concrete) and other construction related materials can cause soil, runoff and groundwater contamination.</p>
<p>Management Measures:</p>	<p>Construction contractor/applicant will ensure that all building materials / chemicals are effectively stored and managed. In the unlikely event of a spillage, an incident will be registered and sufficient clean-up procedures will be carried out immediately.</p> <p>Any hazardous substances will be handled according to the relevant legislation relating to transport, storage and use of the substance (Material Safety Handling Datasheets).</p>

	<p>All construction vehicles will be in a good working condition, will be parked/stored off site (when not working) and will be maintained/serviced off the site to prevent any leakages or spillages of hydrocarbons (fuel, oils & greases). If emergency maintenance is required on site, drip trays and/or absorbent mats will be placed underneath the vehicles/equipment where maintenance work is conducted.</p> <p>If hydrocarbons are leaked or spilled, immediate rehabilitation with a product such as that produced by Drizit or Ecodynamics will be used and contaminated soils will be removed for disposal off-site. Waste manifests for safe disposal will be kept. Rehabilitation kits produced by Ecodynamics are environmentally friendly in that hydrocarbons can be recovered (recycling) and the remains biodegrade (no waste to be disposed).</p>
<p>Potential impact:</p>	<p>Poor sanitary practises</p> <p>Improper sanitary practises or facilities could lead to soil, runoff and/or groundwater contamination.</p>
<p>Management Measures:</p>	<p>Portable dry chemical toilets can be provided by the construction contractor/ applicant for use by workers or existing facilities can be used with the condition of an upgraded sewage treatment plant. Chemical toilets will be serviced as required to prevent overflows. Construction contractor/applicant will ensure that there are an appropriate number of mobile dry chemical toilets on site (typically 1 toilet for 20 people). Contractor/applicant to provide suitable ablution facilities (washing and changing area) for construction workers. No builders/workers will be housed on the site. Ablutions outside the provided facilities are not to occur under any circumstances.</p>
<p>Potential impact:</p>	<p>Poor solid waste management practises</p> <p>Poor solid waste management practises can lead to soil contamination and unsightly construction zones as well as pests/vermin and associated health issues. Waste streams include:</p> <ul style="list-style-type: none"> • Solid construction waste generated through construction or demolition activities. • Biodegradable waste generated through the removal of vegetation. • General waste produced by builders (biodegradable and non-biodegradable).
<p>Management Measures:</p>	<p>Construction waste (building rubble) and general waste will be collected in suitable containers (drums/skips/bins on the property). General waste can be recycled with current general waste and collected by the current contractor. The construction contractor/applicant will ensure sufficient containers are available for storage of waste prior to removal off site to prevent overflow and littering on the site and surroundings. Storage containers will be clearly marked (and/or colour coded) in terms of what waste can be stored in it. Though no special disposal</p>

	<p>methods are required (non-hazardous waste), non-biodegradable refuse such as glass bottles, plastic bags, etc. must be stored in suitable containers to allow for recycling and emptied on an as-required basis for recycling purposes during the construction and clean-up phase. Furthermore, the construction contractor/applicant will ensure that no litter, refuse, waste, rubble and construction waste generated on the premises is placed, dumped or deposited on this, adjacent or surrounding properties during or after construction. Litter patrols will be organised by the construction contractor/applicant. The contractor/applicant will keep copies of all waste manifests showing responsible handling and disposal by a reputable waste transporter. No burning of waste is allowed.</p>
Noise	
<u>Elevated noise levels</u>	
Potential impact:	Noise generated by construction crew/equipment that can disturb ecological cycles and the surrounding community.
Management Measures:	Construction contractor/applicant will ensure vehicles are road worthy. Construction will take place only during regular working hours and day time (7:00 – 17:00) and not on weekends or public holidays to minimize disturbance to neighbours as well as the surrounding ecology.
Air pollution	
<u>Emissions into the atmosphere</u>	
Potential impact:	Emissions may be released into the atmosphere resulting from vehicles and machinery (carbon monoxide emissions, smoke), dust (site clearance), solvents, cooking fires (workers) and malodours as a result of waste not being removed from the construction site.
Management Measures:	All vehicles and machinery used on, or entering, the site must be maintained and serviced regularly to ensure that they do not emit smoke or fumes. The contractor's representative or environmental officer must ensure that all on-site vehicles comply with the old SABS 0181 standards (now SANS 10181:2003 in conjunction with SANS 10281:2003). Dust must be suppressed on access roads and construction sites, especially during dry periods, through the regular application of water or a biodegradable soil stabilisation agent. Water used for this purpose must be used in quantities that will not result in the generation of runoff.

	<p>Any solvent based finishes such as paints, varnishes, sealants and polishes will contain minimal levels of volatile organic compounds (VOC's) and no chloro fluoro carbons (CFC's) which may harm the atmosphere. Water-based paints are to be used where possible (interior) and plant based stains and sealants must be considered as these are more environmentally-friendly.</p> <p>No ad hoc cooking or heat fires are to be allowed on site.</p> <p>Waste must be disposed, as soon as possible to a skip or on a permitted landfill site. Waste must not be allowed to stand on site to decay, resulting in malodours and attracting vermin.</p> <p>A complaints register must be kept throughout the reconstruction phase.</p>
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**Operational phase
(Indefinite)**

Land use and Soil

Potential impact



Change in land use:

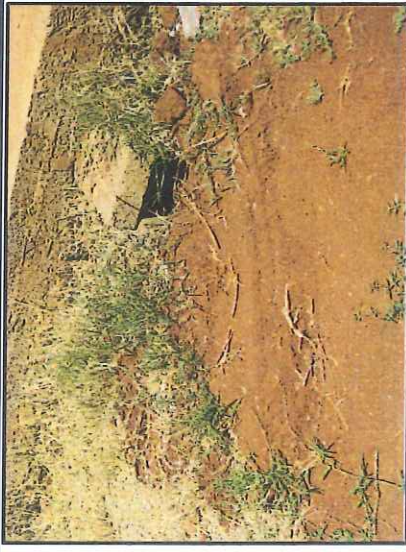
The current zoning of the property is agricultural. Specific reference is made within all the Title Deeds of the subdivisions that the properties should remain as orchards. However, with the construction of accommodation facilities in 1999 and the further expansion thereof, agricultural practices were eliminated. The properties however, have not been rezoned from agricultural land use to residential. An application for township establishment (Towncomp, August 2013) has been submitted and this will need to be authorised to allow the development to continue. Loss of agricultural land has already spanned over 14 years (since the start of the project in 1999); the loss is not seen as significant to the agricultural produce. The Department of Agriculture approved the sub-division of the agricultural property into portions too small to practice farming on an economically feasible basis.

Soil pollution:

Litter was found to be scattered around the site. Current waste disposal includes the collection of waste bins, sorting and recycling of waste found. Some individuals however still dispose of waste incorrectly through littering throughout the site, causing pollution.

Sewage overflow is another source of soil pollution when it occurs and requires an adequate system to prevent such incidences. Wastewater (treated sewage) used for irrigation must be according to DWA standards or this will further contribute to soil pollution (as per table at the end of the document).

	 <p>Waste bins in front of residential units</p>	 <p>Littering found on site</p>
<p>Management Measures:</p>	<p>Rezoning of the farm portions involved will be required. Due to the fact that subdivision of the property was previously approved by DAFF (Authorisation 33504), agriculture use is no longer feasible.</p> <p>Littering must not be tolerated. Due to fact that a waste management system is already in place but not followed, it is suggested that individuals that litter despite the availability of waste bins are fined. Notification must be given to all residents about Estate rules and regulations including the correct disposal of waste and the fines that will be instated if found littering.</p> <p>The sewage system will require upgrading, or the SPUD system that is a waterless system can be implemented to further reduce the probability of pollution. These systems are explained in detail under the socio-economic impacts.</p>	
<p>Surface water</p>		
<p>Potential impact:</p>	<p>Storm water runoff velocity and pollution</p> <p>Currently there is no sufficient storm water management on site. In some areas the storm water seems to be channelled, however it flows over surfaces and eventually drains into the Hex River east (700m) of the site. Not only does the storm water velocity slightly increase because there are more impermeable surfaces, but any pollution on site is then spread to the surrounding properties and the Hex River.</p>	

		
<p>The current extent of storm water management on site</p>		
<p><u>Olifantsnek Irrigation canal</u></p>		
<p>Currently the northern wall of De Brough Estate borders on the Olifantsnek Irrigation Scheme canal. For this reason, this canal can easily be blocked by litter and debris which in turn pollutes and hinders the water, which supplies the farming community from reaching them.</p>		
<p>Management Measures:</p>	<p>A storm water management plan and the associated drainage structures and silt traps required must be put in place. This can include rainwater harvesting, which in turn also provide clean water that can be used for irrigation.</p> <p>It must be ensured that where the Olifantsnek Irrigation Scheme canal can be affected by the De Brough Estate, the canal is maintained in a good condition. No water flowing to surrounding farmers may be intercepted and the canal must remain clear of any pollution, debris, litter etc. Weekly inspections are suggested.</p>	
<p><u>Groundwater</u></p>		
<p><u>Groundwater yield and contamination</u></p>		
<p>Potential impact:</p>	<p>From the groundwater specialist studies (Geologic, 2013), it has been determined that there is currently only 17.25m³/day of groundwater available for use on this property. De Brough Estate, however, currently requires 60m³/day water to supply its needs. The groundwater aquifer is currently already being exploited by different users</p>	

	<p>and if the current unsustainable use continues, the aquifer can in future run dry. The current volume used will need to decrease and another source must be established for potable water to residents.</p> <p>It was also found that BH2 and BH4 are contaminated with NO₃ (probably derived from sewage) and Mg. BH1 is contaminated with E-coli (probably derived from sewage). Based on these findings, the water from these boreholes cannot be used for human consumption unless treated.</p>
<p>Management Measures:</p>	<ul style="list-style-type: none"> • Another water supply source will need to be found along with the groundwater source. No more than 17.25m³/day groundwater can be used. Options include water from the Olfantsnek Irrigation Scheme, which has been applied for. • Daily rainfall measurements need to be taken. • The groundwater needs to be treated (chlorinated) to ensure it is safe for human consumption. This needs to occur immediately. Findings must prove that E-coil has been eliminated from the water within 1 month. <ul style="list-style-type: none"> ○ Magnesium: Lime softening followed by recarbonation is most commonly used for treatment of domestic water supplies. Due to magnesium levels, household appliances will require regular descaling. ○ Nitrate: Nitrate is not readily removed from domestic water supplies. A water treatment plant will be required and costly treatment such as ion exchange or reverse osmosis will have to be considered. ○ Bacterial contamination: Viruses are inactivated by exposure to sunlight. Disinfection with chlorine (or other oxidising agents) is commonly used. • The sewage treatment facility needs to be upgraded to ensure sufficient capacity and to ensure the end product of acceptable quality for disposal/irrigation. • No irrigation of treated wastewater may occur closer than 200m from boreholes and residents. • If the sewage system is an upgraded treatment facility rather than a SPUD system that will eliminate most of these impacts, it should preferably be located in the northern section of the site, at least 200m away from boreholes, <ul style="list-style-type: none"> • BH1, 2, 3 and 4 need to be monitored: <ul style="list-style-type: none"> ○ Monthly - water levels (after 12-hour rest period), abstraction volumes (flow meters) ○ Bi-annual – TDS, Turbidity, Nitrate, Faecal Coliform count, Total Plate count, Coliform count, COD, and Phosphate ○ Annual - geohydrologist report on water quality and groundwater level responses

Noise and Air

Unpleasant smells

The use of wastewater (treated sewage) for irrigation as well as the sewage treatment facility itself currently emanates unpleasant smells. Neighbouring landowners complain of the smell and it affects business/guests of a luxury guesthouse south and directly opposite the sewage treatment facility.



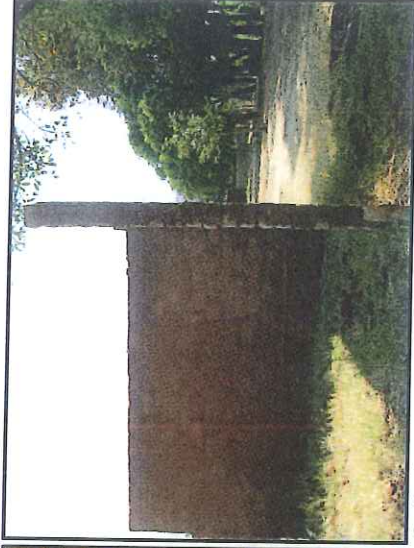
Wastewater (treated sewage) being used for irrigation on site



The current sewage treatment facility

Potential impact:

<p>Management Measures:</p>	<p>As per previous mitigation, it is suggested that a SPUD system be implemented on site or an upgraded sewage treatment facility that will reduce that current smells and pollution of the environment.</p>
<p>Socio-economic</p>	
<p>Potential impact:</p>	<p><u>Accommodation for disadvantaged individuals (positive)</u></p> <p>It is important to note that although the only positive impact of the project it is a very important one. There is currently no accommodation facility except De Brough Estate for these disadvantaged individuals (the elderly, disadvantaged individuals with babies/children). Due to the fact that there are no alternative accommodation available, it is a benefit to 200 families that this establishment continues</p> <p><u>Accommodation not according to building regulations and NHBC</u></p> <p>Currently there is no approved building plan and it is speculated that accommodation has not been built according to building regulations and the NHBC. It was found that most walls consisted of a single brick layer; the walls are unstable and can collapse on occupants. Development has occurred on servitudes that should remain open (under power lines, Olifantsnek Irrigation canal, road servitude) and in some instances the walls of the homes are the walls of the project boundary. The home boundaries that form part of the project area boundary is a traffic obstruction due to the fact that it is in the road servitude, which in turn is a safety issue to road travellers and the occupants of the homes if an accident should occur.</p> <div style="display: flex; justify-content: space-around;">   </div> <p style="text-align: right;">Homes build as part of the project boundary wall</p>



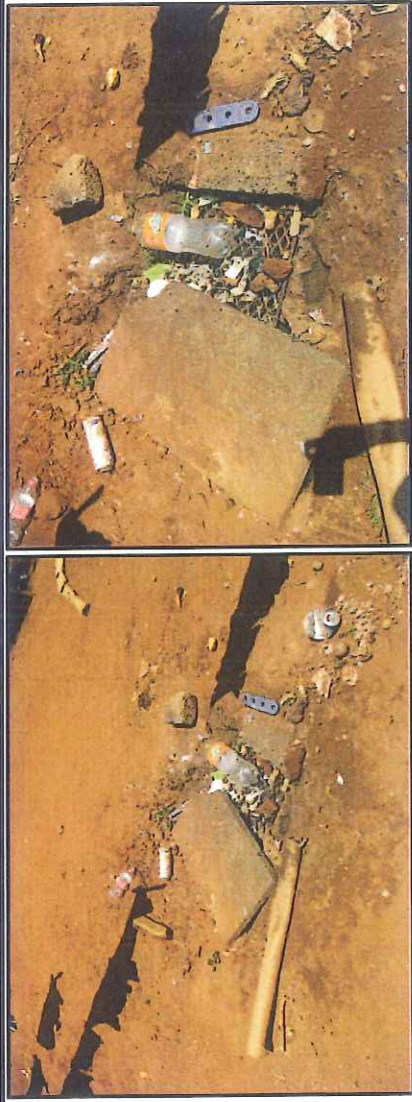
Single brick layer walls that are unstable

The need for services

Electricity: Currently, electricity is supplied by RLM. Electrical wiring was found to be exposed which poses a risk of electrocution and/or a fire hazard.

Potable water: The current source of potable water is groundwater, however as per findings of the geohydrological study (Geologic, 2013), this source is not sufficient for water supply (can supply 17.25m³/day). Current exploitation of groundwater by a number of water users can result in the aquifer running dry in the future. Current abstraction rates on De Brough Estate can affect the groundwater available to surrounding land owners and other water users.

Grey water must form part of a sufficient storm water management plan or must be re-used if possible.

	 <p style="text-align: center;">Current grey water management on site</p> <p>Sewage facilities: A sewage treatment facility exists on site for the treatment and disposal of sewage. After processing the raw sewage, effluent is used for irrigation. However, this sewage treatment facility is the cause of pollution and needs to be upgraded or replaced as it proves insufficient. Overflows and contamination occurs. The effluent (treated sewage) needs to comply with irrigation standards. Smells are a nuisance to surrounding landowners. This, in turn, can cause health effects.</p>
<p>Management Measures:</p>	<p>Accommodation standards (forms part of reconstruction phase above)</p> <p>The current accommodation will need to be upgraded as per approved building plan and building regulations (NHBRC). Any structures within servitudes must be removed.</p> <p>Services</p> <p>Electricity: The electricity on site will need to be upgraded by a qualified electrician and an Electrical Certificate of Compliance will need to be issued. All electrical devices and wiring must be enclosed and locked/secured to prevent any risk of electrocution. Fire extinguishers need to be strategically placed on site in the case of a fire as well as an assembly point which residents must be aware of along with a fire escape route. The amount of fire extinguishers required will be established through classification after the reconstruction phase.</p> <p>Potable water: Another source of potable water will be required. An application has been lodged with the Olifantsnek Irrigation Scheme to increase the currently approved quantities of Member 013 (currently</p>

8 565m³/annum). This water however, is meant for irrigation and not human consumption, therefore an approved water treatment facility will need to be erected to treat the water (which water sampling must proof adequate) for human use. Potable water standards with which water quality must comply with is as follows:

Variable (as mg/l unless otherwise indicated)	South African Water Quality Guidelines (DWAf, 1996)	SABS 241 (1999) (South African Bureau of Standards)
	Domestic use	Class 0
pH	6 – 9	Ideal
TDS	< 450	6 - 9
Ca	< 32	< 450
Mg	< 30	< 1 000
Na	< 100	< 150
K	< 50	< 30
NH ₃ (as N)	< 1.0	< 100
NO ₃ (as N)	< 6	< 25
SO ₄	< 200	< 0.2
Cl	< 100	< 6
F	< 1	< 200
Coliforms (counts/100 ml)	0 (faecal) < 5 (total)	< 100 < 0.7 0
		< 1 10 (total) 1 (faecal)

Sewage treatment:

SPUD system (preferred option)

The SPUD system is a waterless dehydration toilet and characteristics of this system include:

- It is 100% Waterless
- It is an odourless and chemical free process, and a closed system.
- No linkage to sewerage system required
- It is solar powered to enhance the aerobic processes
- Simple DIY installation
- Warranty – 30 years
- Produces a safe to handle mature inoffensive compost-like material.



Photos of the SPUD system

An upgraded sewage treatment facility

The basic principles of treatment will need to be adhered to. The treatment of sewage involves the systematic removal or conversion of the harmful constituents present in the sewage. A typical and logical sequence of the wastewater treatment processes is as follows:

Preliminary treatment

Materials such as rags, plastics, sand, metal particles, etc. are transported through the system with the wastewater. Although only a small proportion of the total wastewater flow, it can have adverse effects on further treatment processes and can cause damage to plant equipment and must be removed. Preliminary treatment of wastewater occurs at the head of the works and generally includes screening, grit removal and flow measurement.

Primary treatment

Organic and inorganic solids are removed by sedimentation, and floatable material is removed by skimming. Typically, a BOD reduction of 25% to 50% is achieved and 50% to 70% of the SS (suspended solids), and 65% of the oil and grease are removed. "A primary sedimentation tank is defined as a tank in which wastewater is retained long enough to bring about sedimentation of suspended matter but short enough to prevent anaerobic decomposition of the sludge."

Secondary treatment

"Secondary treatment is the second step in most wastewater treatment systems during which bacteria consume the organic parts of the wastes. This is accomplished by bringing the sewage, bacteria and oxygen together in trickling filters or within an activated sludge process." Micro-organisms and oxygen are utilized during secondary treatment to stabilize the sewage after primary treatment and 85% to 95% of the SS and the BOD load can typically be removed. Secondary treatment processes include percolating filters (trickling filters or rotating biological filters), rotating biological contractors, and activated sludge processes, which normally consist of aeration tanks (where air (oxygen) is injected into the primary treated wastewater), sedimentation tanks (where the activated sludge is separated from the liquid) and final clarifiers.

Tertiary treatment

"Tertiary treatment is the advanced treatment process, following secondary treatment of wastewater that produces high quality water. Tertiary treatment includes removal of nutrients such as phosphorus and nitrogen and practically all suspended and organic matter from wastewater." During tertiary treatment (which includes filtration, phosphorus removal, ammonia stripping and other special treatments), specific constituents are removed. Further treatment may include sand filtration, wetlands or other advanced treatment processes. This currently does not form part of the sewage treatment facility on site and will need to be incorporated along with sufficient equipment for the above processes.

Disinfection

Methods for disinfection are:

- Chemical, e.g. chlorination and ozonation
- Physical, e.g. ultraviolet radiation and microfiltration
- Biological, e.g. detention ponds

Treatment Effluent Quality	Preliminary	Primary	Secondary	Tertiary
SS BOD	300 - 400 mg/l 300 - 500 mg/l	120 - 200 mg/l 180 - 240 mg/l	30 - 40 mg/l 30 - 40 mg/l	
	<p>A basic schematic of a sewage treatment facility</p>			
	<p>The system must be DWA approved and no end products may be re-used (such as for irrigation purposes) unless it complies with DWA standards and it may not occur within 200 of residents or boreholes. Water quality standards for irrigation can be seen below:</p>			
Variable (as mg/l unless otherwise indicated)	South African Water Quality Guidelines (DWA, 1996) <i>Agricultural use</i> Irrigation		General Authorisation (GNR 665, 6 Sep 2013) for 50m³/day	
pH	6.5 - 8.4		6 - 9	
TDS (mg/l)	< 260		< 1 300 (200mS/m)	
SAR	< 1.5		< 5	
COD (mg/l)			< 5 000	
Coliforms (counts/100 ml)	< 1 (faecal)		< 100 000	

3. IMPACT OF NO-GO OPTION

Approximately 200 families will be homeless. These individuals are also fragile as it includes the elderly and babies/small children. The no-go option will severely impact on these 200 families unless an alternative accommodation facility that is affordable can be supplied to these families.